National Park Service
U.S. Department of the Interior

Curecanti National Recreation Area
Colorado

CURECANTI
NATIONAL RECREATION AREA

Personal Watercraft Use

Environmental Assessment

Printed on recycled paper

National Park Service
U.S. Department of the Interior

Curecanti National Recreation Area
Colorado

CURECANTI
NATIONAL RECREATION AREA

Personal Watercraft Use

Environmental Assessment

April 2003

SUMMARY

Curecanti National Recreation Area (Curecanti) was established in 1965 to provide for conservation of scenic, natural, historic, archeological and wildlife values. The goal of the National Recreation Area is to provide for public use and enjoyment while ensuring visitor safety, resource preservation and conservation. Curecanti is located on U.S. Highway 50 (U.S. 50), west of Gunnison, Colorado.

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for managing personal watercraft (PWC) use at Curecanti to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national recreation area's authorizing memorandum of agreement, purpose, mission, and goals. Upon completion of this process, in accordance with the *National Environmental Policy Act* (NEPA), the National Park Service (NPS) may either take action to adopt special regulations to manage PWC use, or it may not reinstate PWC use at this park unit.

BACKGROUND

More than one million personal watercraft are estimated to be in operation today in the United States. Sometimes referred to as "jet skis" or "wet bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the 60 mile-per-hour (mph) range. Personal watercraft were once the fastest growing segment of the boating industry and represented over one-third of total sales. National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001. While PWC use remains a relatively new recreational activity, it has occurred in 32 of the 87 national park system units that allow motorized boating.

After studies in Everglades National Park showed that PWC use resulted in damage to vegetation, adversely impacted shorebirds, and disturbed the life cycles of other wildlife, the NPS prohibited PWC use by a special regulation at the park in 1994. In recognition of its duties under its *Organic Act* and NPS *Management Policies,* as well as increased awareness and public controversy about PWC use, the National Park Service subsequently reevaluated its methods of PWC regulation. Historically, the National Park Service had grouped personal watercraft with all vessels; thus, PWC use was allowed when the unit's superintendent's compendium allowed the use of other vessels. Later, the National Park Service closed seven units to PWC use through the implementation of horsepower restrictions, general management plan revisions, and park-specific regulations such as those promulgated by Everglades National Park.

In May 1998, the Bluewater Network filed a petition urging the National Park Service to initiate a rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the National Park Service issued an interim management policy requiring superintendents of parks where PWC use can occur but had not yet occurred to close the unit to such use until the rule was finalized. The National Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. On March 21, 2000, the National Park Service issued a regulation prohibiting PWC use in most units and required 21 units to determine the appropriateness of continued PWC use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service, challenging the NPS' decision to allow continued PWC use in 21 units while prohibiting PWC use in other units. In response to the suit, the National Park Service and the environmental group negotiated a settlement. Each

park desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the National Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with NEPA. The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

As the settlement deadline approached and the park units were preparing to prohibit PWC use, the National Park Service, Congress, and PWC user groups sought legal methods to keep the parks open to this activity. However, no method was successful. After November 6, 2002, Curecanti was closed for PWC use. If, as a result of this environmental assessment, an alternative is selected that would allow PWC use to be reinstated, then a special regulation to authorize that use will be drafted.

ALTERNATIVES CONSIDERED

This environmental assessment evaluates three alternatives concerning the use of personal watercraft at Curecanti.

- Alternative A would reinstate PWC use under a special regulation as previously managed.
- Alternative B would reinstate PWC use under a special regulation with additional management prescriptions. (The park has identified alternative B as the preferred alternative.)
- The no-action alternative would allow no PWC use. No special rule would be promulgated.

Based on the environmental analysis prepared for PWC use at Curecanti, alternative B is considered the environmentally preferred alternative because it would best fulfill park responsibilities as trustee of this sensitive habitat; ensure safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and attain a wider range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.

ENVIRONMENTAL CONSEQUENCES

Impacts of the three PWC management alternatives were assessed in accordance with *Director's Order #12: Conservation Planning, Environmental Impact Analysis and Decision-Making.* The *Director's Order #12 Handbook* requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

To determine impacts, methodologies were identified to measure the change in park resources that could occur with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions, both adverse and beneficial.

Each PWC management alternative was compared to a baseline to determine the context, duration, and intensity of resource impacts. The baseline, for purposes of impact analysis, is the reinstatement of PWC use and previous management projected over the next 10 years (alternative A).

Table A summarizes the results of the impact analysis for the impact topics that were assessed in the "Environmental Consequences" chapter. The analysis considered a 10-year period (2002–2012).

TABLE A: SUMMARY OF THE IMPACT ANALYSIS

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Water Quality	PWC use impacts: Negligible to minor adverse effects in 2002 and 2012 based on impacts from benzo(a)pyrene, naphthalene and benzene (human health (ingestion of water and fish). Cumulative impacts: Negligible adverse in 2002 and 2012 for benzo(a)pyrene, naphthalene, and benzene would be minor to moderate adverse based on human health benchmarks and EPA and State of Colorado water quality criteria. Impacts would be reduced to minor adverse impacts when the half-life of benzene is considered.	PWC use impacts: Same as alternative A. Cumulative impacts: Same as alternative A.	PWC use impacts: Beneficial impact with eliminating personal watercraft. Cumulative impacts: Similar to alternative A, remaining motorboats would be negligible adverse for all ecotoxicological benchmarks. Impacts would be reduced to minor adverse impacts when the half-life of benzene is considered.
Air Quality	PWC use impacts: Negligible adverse impacts for CO, HC, PM_{10} and NO_x for the year 2002. In 2012, the impact level would remain negligible adverse. Risk from PAH would be negligible. Cumulative impacts: Negligible adverse for PM_{10}, HC, and NO_x, and minor adverse for CO in 2002 and 2012. CO emissions would increase from 2002 to 2012. Existing air quality maintained, with future reductions in PM_{10} and HC emissions due to improved emission controls.	PWC use impacts: Same as alternative A. Cumulative impacts: Same as alternative A.	PWC use impacts: Beneficial impacts from banning PWC use because of decreased emissions. Cumulative impacts: Reduced emissions from other craft as compared to alternative A, with no contribution from PWC use. Negligible adverse for PM_{10}, HC, and NO_x, to minor adverse for CO. Future emission levels would remain relatively stable, with increased CO emissions and slightly increased NO_x emissions as a result of increased boating activity and the conversion to cleaner engines. HC and PM_{10} would continue to decline, but impacts would remain negligible to minor and adverse.
Air Quality Related Values from PWC Pollutants	PWC use impacts: Minor adverse impacts from PWC. Cumulative impacts: Minor adverse from motorized boats and personal watercraft in both 2002 and 2012 based on pollutant emissions being less than 50 tons per year, no observed visibility impacts or ozone-related plant injury, and regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations.	PWC use impacts: Same as alternative A. Cumulative impacts: Same as alternative A.	PWC use impacts: Beneficial impacts on air quality related values. Cumulative impacts: Minor adverse impacts from motorized boat emissions in both 2002 and 2012, based on regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Soundscapes	PWC use impacts: Minor to moderate adverse impacts at most locations on Blue Mesa Reservoir and immediate surrounding area. Impact would be related to the number of personal watercraft operating as well as the sensitivity of other visitors. Cumulative impacts: Minor to moderate adverse with sounds heard occasionally throughout the day, and may predominate on busy days during the high use season.	PWC use impacts: Similar to alternative A except beneficial impacts from speed and wake restrictions and creation of buffer zones. Cumulative impacts: Similar to alternative A.	PWC use impacts: Occasionally noticeable beneficial effect from banning personal watercraft since on the high use days personal watercraft compromise approximately 7% of total motorized use. Cumulative impacts: Beneficial impact with no PWC contribution.
Wildlife and Wildlife Habitat	PWC use impacts: Negligible adverse effects on fish, and negligible to minor impacts on waterfowl and other wildlife. Impacts to fish, wildlife and respective habitats would be temporary and short term. Cumulative impacts: Minor adverse effects on wildlife and wildlife would be temporary and short term.	PWC use impacts: Similar to alternative A except additional limitations on PWC use would slightly reduce impacts on wildlife. Expanded wake restrictions would result in a beneficial impact. Cumulative impacts: Same as alternative A.	PWC use impacts: Beneficial impact with elimination of interactions between PWC users and wildlife with potential increased use of these areas by wildlife and waterfowl. Cumulative impacts: Similar to alternative A except no PWC contribution to overall impacts to wildlife and wildlife habitat.
Threatened and Endangered, and Special Concern Species	PWC use impacts: May affect, but is not likely to adversely affect to federal or state listed species. All park sensitive species are unlikely to be affected in the short or long term. Cumulative impacts: Not likely to adversely effect listed species to special status species due to lack of species occurrences as well as a lack of access to the species or their habitats.	PWC use impacts: Similar to alternative A except buffer zones and speed restrictions could result in beneficial impacts to some species. Cumulative impacts: Similar to alternative A.	PWC use impacts: Beneficial impact to the wildlife species of concern due to a ban on PWC use. Cumulative impacts: Similar to alternative A except PWC contribution to overall cumulative impacts to protected species would be eliminated.
Shorelines and Shoreline Vegetation	PWC use impacts: Negligible adverse effect over the short and long-term. Cumulative impacts: Negligible to minor adverse in the short and long- term due to wind-related erosion, wave action, and other visitor activities such as boating.	PWC use impacts: Beneficial impacts over the short and long term. The shoreline buffer would provide some additional protection. Cumulative impacts: Beneficial impacts due to shoreline buffer.	PWC use impacts: Beneficial impacts over the short and long term from banning PWC use. Cumulative impacts: Negligible to minor, but adverse, due to continued boating use and some wind-related erosion.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Visitor Use and Experience	PWC use impacts: Negligible to minor adverse impacts on experiences for most visitors in the short and long-term. Swimmers and other motorized boat users would be most affected by PWC use because of the popularity of the day use areas especially at Dry Creek Picnic Area, Bay of Chickens, and the windsurfing beach. Long-term negligible to minor adverse impacts for visitors who desire a more passive recreational experience and desire natural quiet. Cumulative impacts: Negligible to minor adverse impacts in the short and long-term.	PWC use impacts: Negligible to minor adverse impact on most PWC users, because most of the more popular PWC use locations at the park would remain available. Shoreline users seeking more natural surroundings, and non-motorized and motorized boaters using the lake arms would experience beneficial impacts and visitors using the main body would experience negligible to minor adverse impacts. Cumulative impacts: Similar to alternative A.	PWC use impacts: Beneficial impact on the experiences of most non-PWC using visitors due to the ban of personal watercraft. Impacts on PWC users, particularly local residents would be short and long term, moderate to major, and adverse. Cumulative impacts: Beneficial as compared to alternative A. Negligible to minor adverse impacts at other waterbodies in the region as a result of PWC users going to other locations to enjoy this activity.
Visitor Conflicts and Safety	PWC use impacts: Short-term negligible to minor adverse and long-term, minor adverse impacts on visitor conflicts and safety, particularly in the noted high PWC use locations due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts at other locations would remain negligible adverse because use is lower and conflicts would be less likely to occur. Cumulative impacts: Minor adverse for all user groups in the short and long term, particularly near the high-use areas; negligible adverse in other areas of the reservoir.	PWC use impacts: Short- and long-term, minor to moderate adverse impacts on visitor conflicts and safety in the high use areas and boat launches due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts along the south shore and at lake-arm locations would be negligible to minor adverse because PWC zoning would reduce the potential for conflicts. Cumulative impacts: Minor to moderate adverse for all user groups in the short and long term, particularly near the high-use areas. Cumulative impacts in lake arms would be negligible adverse because of reduced use.	PWC use impacts: Short- and long-term, beneficial impacts by reducing visitor conflicts and enhancing safety. PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be beneficial. Cumulative impacts: Minor short- and long-term, adverse impacts for other uses.
Cultural Resources	PWC use impacts: Minor adverse impacts on listed or potentially listed archeological sites from possible illegal collection and vandalism. Cumulative impacts: Minor to major adverse, due to the number of visitors and the potential for illegal collection or destruction.	PWC use impacts: Minor adverse impacts on listed or potentially listed archeological resources from possible illegal collection and vandalism. Based on speed zones and speed restrictions from arm areas into main body areas. Beneficial impact on those resources from the reduced erosion resulting from higher speeds. Cumulative impacts: Minor to major and adverse effects of other activities on archeological resources that are readily accessible due to the number of visitors and the potential for illegal collection or destruction.	PWC use impacts: Beneficial impacts on archeological sites. Cumulative impacts: Minor to major effects, accessibility of the resource and the potential for illegal collection or damage by other users. No increase based on PWC use.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Socioeconomic Effects	No change in consumer surplus for PWC users or other visitors. No change in producer surplus to producers of PWC or non-PWC services. No change in welfare to local residents or the general public.	Very slight decrease in consumer surplus for PWC users. Slight increase in consumer surplus of non-PWC visitors. No change in producer surplus of producers of PWC services and small increase in producer surplus for producers of non-PWC services. Slight decrease in welfare to local residents who use PWC. Slight increase in welfare of local residents who do not use PWC as well as to the general public.	Decrease in consumer surplus for current and future PWC users. Increases in consumer surplus for most non-PWC visitors. Decrease in producer surplus for PWC rental and retail shops. Decrease in producer surplus for hospitality services in the area. Increase in producer surplus for producers of services to non-PWC park visitors. Increase in welfare to the general public and local residents who do not use PWC. Decrease in welfare to local residents who use PWC.
National Recreation Area Management and Operations			
Conflicts with State and Local Regulations	Negligible impacts since no conflicts with state or local regulations occur.	Same as alternative A.	No conflicts.
Impact to Park Operations from Increase Enforcement Needs	PWC use impacts: Moderate adverse impacts on park operations (more staff, funding, equipment, and educational material to regulate use).	PWC use impacts: Similar to alternative A, plus educational supplies needed.	PWC use impacts: Negligible adverse impacts on park operations with no additional staff, funding, or equipment.

CONTENTS

MAPS

TABLES

PURPOSE OF AND NEED FOR ACTION

Curecanti National Recreation Area (Curecanti), a unit of the national park system, was established in 1965 to provide for conservation of the scenic, natural, historic, archeological, and wildlife values. The goal of the recreation area is to provide for public use and enjoyment while ensuring visitor safety and resource preservation and conservation. Curecanti is located on U.S. 50, west of Gunnison, Colorado (map 1).

More than one million personal watercraft[1](PWC) are estimated to be in operation today in the United States. Sometimes referred to as "jet skis" or "wet bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the range of 60 miles per hour (mph).

The National Park Service (NPS) maintains that PWC use emerged and gained popularity in park units before it could initiate and complete a "full evaluation of the possible impacts and ramifications." While PWC use remains a relatively new recreational activity, it has occurred in 32 of 87 park units that allow motorized boating.

The National Park Service first began to study personal watercraft in Everglades National Park. The studies showed that PWC use over emergent vegetation, shallow grass flats, and mud flats commonly used by feeding shore birds damaged the vegetation, adversely impacted the shore birds, and disturbed the life cycles of other wildlife. Consequently, managers at Everglades determined that PWC use remained inconsistent with the resources, values, and purposes for which the park was established. In 1994, the National Park Service prohibited personal watercraft by a special regulation at the park (59 *Federal Register* [FR] 58781).

Other public entities have taken steps to limit, and even to ban, PWC use in certain waterways as national researchers study more about the effects of PWC use. At least 34 states have either implemented or have considered regulating the use and operation of personal watercraft (63 FR at 49314). Similarly, various federal agencies, including the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, have managed personal watercraft differently than other classes of motorized watercraft.

Specifically, the National Oceanic and Atmospheric Administration regulates the use of personal watercraft in most national marine sanctuaries. The regulation resulted in a court case where the Court of Appeals for the District of Columbia declared such PWC-specific management valid. In *Personal Watercraft Industry Association v. Department of Commerce*, 48 F.3d 540 (D. C. Cir. 1995), the court ruled that an agency can discriminate and manage one type of vessel (specifically personal watercraft) differently than other vessels if the agency explains its reasons for the differentiation.

In February 1997, the Tahoe Regional Planning Agency (TRPA), the governing body charged with ensuring no derogation of Lake Tahoe's water quality, voted unanimously to ban all two-stroke, internal

1. Personal watercraft, as defined in 36 CFR §1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aft most part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

combustion engines including personal watercraft because of their effects on water quality. Lake Tahoe's ban began in 2000.

In July 1998, the Washington State Supreme Court in *Weden V. San Juan County* (135 Wash. 2d 678 [1998]) found that the county had the authority to ban the use of personal watercraft as a proper use of its police power in order to protect the public health, safety, or general welfare. Further, personal watercraft are different from other vessels, and Washington counties have the authority to treat them differently.

In recognition of its duties under the *Organic Act* and NPS *Management Policies,* as well as increased awareness and public controversy, the National Park Service reevaluated its methods of PWC regulation. Historically, the National Park Service grouped personal watercraft with all vessels; thus, people could use personal watercraft when the unit's superintendent's compendium allowed the use of other vessels. Later the Park Service closed seven units to PWC use through the implementation of horsepower restrictions, general management plan revisions, and park-specific regulations such as those promulgated by Everglades National Park.

In May 1998, the Bluewater Network, a coalition of more than 70 organizations representing more than 4 million Americans, filed a petition urging the National Park Service to initiate a rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the National Park Service issued an interim management policy requiring superintendents of parks where personal watercraft can occur but where it had never occurred to close the unit to such use until the rule was finalized. In addition, the National Park Service proposed a specific PWC regulation premised on the notion that personal watercraft differ from conventional watercraft in terms of design, use, safety record, controversy, visitor impacts, resource impacts, horsepower-to-vessel-length ratio, and thrust capacity (63 FR 49, 312–17, Sept. 15, 1998). The Personal Watercraft Industry Association believes that through the 2002 model year the output on a limited number of higher rated models was around 155 and 165 hp (PWIA 2002b).

The National Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. The preamble to the servicewide regulation calls the regulation a "conservative approach to managing PWC use" considering the resources concerns, visitor conflicts, visitor enjoyment, and visitor safety. During a 60-day comment period the National Park Service received approximately 20,000 comments on the proposed regulation.

As a result of public comments and further review, the National Park Service promulgated an amended regulation that prohibited PWC use in most units and required the remaining units to determine the appropriateness of continued PWC use (36 CFR 3.24(a), current draft; 65 FR 15,077–90, Mar. 21, 2000). Specifically, the regulation allowed the National Park Service to designate PWC use areas and to continue their use by promulgating a special regulation in 11 units by amending the units' superintendents' compendiums in 10 units, including Curecanti National Recreation Area (36 CFR 3.24(b), current draft). Curecanti was one of the compendium parks, not one of the special regulation parks. The National Park Service based the distinction between designation methods on the units' degree of motorized watercraft use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service under the *Administrative Procedures Act* and the NPS *Organic Act*. The organization challenged NPS's decision to allow continued PWC use in 21 units while prohibiting such use in other units. In addition, the organization also disputed the NPS decision to allow 10 units to continue PWC use after 2002 by making entries in superintendents' compendiums, which would not require the opportunity for public input through a notice and comments rulemaking process. Further, the environmental group claimed that because personal watercraft cause water and air pollution, generate increased noise levels, and pose public

safety threats, the National Park Service acted arbitrarily and capriciously when making the challenged decisions.

In response to the suit, the National Park Service and the environmental group negotiated a settlement. The resulting settlement agreement, signed by the judge on April 12, 2001, changed portions of NPS's PWC rule. While 21 units could continue PWC use in the short-term, each of those parks desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the National Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with the *National Environmental Policy Act* (NEPA). The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

In 2001, the National Park Service adopted its new management policy for personal watercraft. The policy prohibits PWC use in national park system units unless their use remains appropriate for the specific park unit (NPS *Management Policies 2001*, sec. 8.2.3.3). The policy statement authorizes the use based on the park's authorizing memorandum of agreement, resources, values, other park uses, and overall management strategies.

As the settlement deadline approached and the park units were preparing to prohibit PWC use, the National Park Service, Congress, and PWC user groups sought legal methods to keep the parks open to this activity. On March 28, 2002, the Personal Watercraft Industry Association filed suit against the National Park Service for its final PWC regulation, challenging its discrimination between personal watercraft and other vessels and the NPS decision to close units without conducting an environmental analysis. PWIA requested the court enjoin the National Park Service from implementing the ban on PWC use effective April 22, 2002. The court refused to enjoin the ban. On April 22, 2002, the following units closed for PWC use: Assateague Island National Seashore, Big Thicket National Preserve, Pictured Rocks National Lakeshore, Fire Island National Seashore, and Gateway National Recreation Area. On September 15, 2002, eight other park units were scheduled to close to PWC use including Curecanti National Recreation Area.

The proposed September 16, 2002 prohibition of personal watercraft was averted with the execution of a stipulated modification to the settlement agreement. The modified settlement agreement was approved by the court on September 9, 2002, and extended unrestricted personal watercraft use in some selected national park system units until November 6, 2002.

PWC use at Curecanti National Recreation Area was stopped after November 6, 2002, and is to remain closed until the environmental assessment process has been completed. If an alternative is selected to continue PWC use, then a special regulation to authorize that use in the future will have to be drafted.

PURPOSE OF AND NEED FOR ACTION

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for the management of PWC use at Curecanti National Recreation Area in order to ensure the protection of park resources and values, while offering recreational opportunities as provided for in the national recreation area's authorizing memorandum of agreement, purpose, mission, and goals. Upon completion of the NEPA process, the National Park Service may either take action to adopt special regulations to manage PWC use at Curecanti, or remain closed to PWC use as allowed for in the National Park Service March 2000 rule.

This environmental assessment evaluates three alternatives concerning the use of personal watercraft at Curecanti. The alternatives include:

- *Alternative A* – Reinstate PWC use under a special regulation as previously managed in accordance with NPS *Management Policies 2001*, park practices, and state regulations.

- *Alternative B* – Reinstate PWC use under a special regulation with additional management prescriptions, such as limiting areas of use. Alternative B has been identified as the preferred alternative.

- *No-Action Alternative* – Eliminate PWC use entirely. No special rule would be promulgated. This environmental assessment also includes an assessment of effect as provided for under the *National Historic Preservation Act*, Section 106.

SCOPE OF THE ANALYSIS

Motorboats and other watercraft have been used in Curecanti since 1975. Personal watercraft have emerged at Curecanti only since their introduction in the 1980s, and particularly since the summer of 1995 when personal watercraft were available for rent from a park concessioner. While some effects of PWC use are similar to other watercraft and, therefore, difficult to distinguish, the focus of this action is in support of decisions and rulemaking specific to PWC use. However, while the settlement agreement and need for action have defined the scope of this environmental assessment, NEPA requires an analysis of cumulative effects on resources of all past, present, and reasonably foreseeable actions when added to the effects of the proposal (40 CFR 1508.7, 2000). The scope of this analysis, therefore, is to define management alternatives specific to PWC use, in consideration of other uses, actions, and activities cumulatively affecting park resources and values.

PURPOSE AND SIGNIFICANCE OF CURECANTI NATIONAL RECREATION AREA

Congress establishes national park system units to fulfill specified purposes, based on a park's unique and significant resources. Curecanti National Recreation Area's authorizing memorandum of agreement serves as the basic building block for its decisions pertaining to conservation of resources and providing for "enjoyment of future generations."

AUTHORIZING INTENT OF CURECANTI NATIONAL RECREATION AREA

The following statements are excerpts from the park's authorizing memorandum of agreement:

> whereas the [Park] Service has been designated as the agency responsible for [administering recreational use]
>
> whereas a large number of persons are expected to use the lands and waters of such withdrawn area for the purposes of recreation
>
> whereas [an] Act … authorizes the use of appropriated funds … for the administration, protection, improvement, and maintenance of areas … devoted to recreational use pursuant to cooperative agreements

> whereas the [Park] Service is experienced in administering areas devoted to recreational use
>
> the Service in its administration of the project area for recreation shall be responsible for….
>
> > Establishing and enforcing policies regarding the recreational use of lands and waters in the project area
> >
> > Promulgating and enforcing such rules and regulations as necessary for…the conservation of historic or archeological remains…or as may be needed for recreational use and enjoyment of the area for the safety of visitors

PURPOSE OF CURECANTI NATIONAL RECREATION AREA

The purpose and significance statements listed below are from Curecanti's *Strategic Plan* (NPS 2001c) and *General Management Plan* (NPS 1997). Curecanti National Recreation Area was established for the following purposes:

- Conserve the scenery, natural, historic, and archeological resources, and wildlife of Curecanti.
- Provide for public use and enjoyment in such a way as to ensure visitor safety and resource preservation or conservation by establishing and maintaining facilities and providing protection and interpretive services.
- Manage the lands, waters, and activities of Curecanti in such a way that it does not interfere with the purposes of the *Colorado River Storage Project Act* and other Bureau of Reclamation agreements affecting the operation of the Aspinall Unit.
- Mitigate the loss of fish and wildlife resources as a result of the Colorado River Storage Project.

SIGNIFICANCE OF CURECANTI NATIONAL RECREATION AREA

The following statements summarize the significance of Curecanti:

- Blue Mesa Reservoir is one of the largest high-altitude bodies of water in the United States. It provides an exciting diversity of water recreation opportunities for windsurfers, sail boaters, and water skiers.
- The scenic values of the canyon, the needles, the pinnacles, and the reservoirs provide dramatic contrast, which causes visitors to slow down, pause, and reflect on the diversity of the landscape and its spaciousness.
- Curecanti provides one of the best cold-water fishing opportunities in the nation. This is due primarily to the Kokanee salmon run occurring in Blue Mesa. The Morrow Point and Crystal Reservoirs' trout fisheries routinely attract fishing enthusiasts from throughout the nation because of the high-quality trout fishing and uniqueness of the canyon environment.

- The prehistoric and historic stories of human culture in the Curecanti area are recorded in the traces and tracks left by Native Americans, miners, railroaders, and ranchers. The signs document not only the human struggles to survive but also how changing human value systems; economic, social, and technological changes; and the importance of water have shaped the use and character of the land and its people. Cultural history contains archeological examples of some of the oldest villages found in North America, predating the building of the pyramids.

- The narrow-gauge railroad exhibit in Cimarron graphically portrays the story of technology's effects of shaping people and using land; the agony and difficulties of building track in narrow canyons in the winter where the sun seldom shined; and of taking the hard way instead of the easy trail. Examples of a locomotive, tender, and caboose used on the railroad are on exhibit at Cimarron.

- Curecanti will preserve, protect, and interpret the tremendous collection of nationally significant, diverse natural and cultural resources balanced with the provision of outstanding recreational opportunities.

The park's mission statement is as follows: "Curecanti National Recreational Area will preserve, protect, and interpret the tremendous collection of nationally significant, diverse natural and cultural resources balanced with the provision of outstanding recreational opportunities."

BACKGROUND

NPS ORGANIC ACT AND MANAGEMENT POLICIES

By enacting the National Park Service *Organic Act of 1916*, Congress directed the National Park Service to manage units under its jurisdiction "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). Congress reiterated this mandate in the *Redwood National Park Expansion Act of 1978* by stating that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1 a-1).

Despite these mandates, the *Organic Act* and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered the National Park Service with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 (9th Cir. 1996)).

Yet, courts consistently interpreted the *Organic Act* and its amendments to elevate resource conservation above visitor recreation. *Michigan United Conservation Clubs v. Lujan,* 949 F.2d 202, 206 (6th Cir. 1991) states, "Congress placed specific emphasis on conservation." The *National Rifle Ass'n of America v. Potter,* 628 F.Supp. 903, 909 (D.D.C. 1986) states, "In the *Organic Act* Congress speaks of but a single purpose, namely, conservation." The NPS *Management Policies* also recognize that resource conservation takes precedence over visitor recreation. The policy dictates "when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant" (NPS *Management Policies 2001,* sec. 1.4.3).

Because conservation remains predominant, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. Yet, the Park Service has discretion to allow negative impacts when necessary (NPS *Management Policies 2001,* sec. 1.4.3). While some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes a resource impairment (NPS *Management Policies 2001,* sec. 1.4.3). The *Organic Act* prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts (16 USC 1 a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS *Management Policies 2001,* sec. 1.4.4). To determine impairment, the National Park Service must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS *Management Policies 2001,* sec. 1.4.4).

Because park units vary based on their authorizing memorandum of agreement, natural resources, cultural resources, and missions, the recreational activities appropriate for each unit and for areas within each unit vary as well. An action appropriate in one unit could impair resources in another unit. Thus, this environmental assessment analyzes the context, duration, and intensity of impacts related to PWC use at Curecanti, as well as potential for resource impairment, as required by *Director's Order # 12: Conservation Planning, Environmental Impact Analysis and Decision-making (DO # 12) and Director's Order #28: Cultural Resource Management (DO # 28).*

SUMMARY OF RESEARCH ON THE EFFECTS OF PERSONAL WATERCRAFT

Over the past two decades personal watercraft use in the United States increased dramatically. However, there are conflicting data about whether PWC use is continuing to increase. While the National Transportation Safety Board (NTSB) estimates that retailers sell approximately 200,000 personal watercraft each year and people currently use another 1 million (NTSB 1998); the PWC industry argues that PWC sales have decreased by 50% from 1995 to 2000 (American Watercraft Association [AWA] 2001). National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001 (see table 1).

TABLE 1: NATIONAL PWC REGISTRATION TREND

Year	Number of Boats Owned	Number of Personal Watercraft Owned	Boat Ownership Trend (Percent Change)	PWC Ownership Trend (Percent Change)
1991	16,262,000	305,915	—	—
1992	16,262,000	372,283	0%	21.7%
1993	16,212,000	454,545	0%	22.1%
1994	16,239,000	600,000	0%	32.0%
1995	15,375,000	760,000	-5%	26.7%
1996	15,830,000	900,000	3%	18.4%
1997	16,230,000	1,000,000	3%	11.1%
1998	16,657,000	1,100,000	3%	10.0%
1999	16,773,000	1,096,000	1%	-0.4%
2000	16,965,000	1,078,400	1%	-1.6%
2001		1,053,560		-2.4%

Source of boat information: USCG 2001.

Source of PWC information: National Marine Manufacturers Association (NMMA) 2002.

The majority of personal watercraft used today are powered by conventional two-stroke engines (NPS 1998, California Air Resources Board [CARB] 1999). Multiple studies have demonstrated that four-stroke engines are substantially cleaner than carbureted, two-stroke engines, generating approximately 90% fewer emissions (Warrington 1999; Oregon Department of Environmental Quality [ODEQ] 1999; TRPA 1999). PWIA notes that direct-injection engines have been available in personal watercraft for four years; and three PWC manufacturers introduced four-stroke engines for the 2002 model year (PWIA 2002a). The U.S. Environmental Protection Agency (EPA) assumes that the existing two-stroke engine models would not be completely replaced by newer PWC technology until 2050 (40 CFR 89, 90, 91).

The average operating life of a personal watercraft is 5 to 10 years, depending upon the source. The formula for determining the operating life of personal watercraft was published in the Federal Register on October 4, 1996 (EPA 1996a). Based on this formula, the National Park Service expects that by 2012, most boat owners will already be in compliance with the 2006 EPA marine engine standards. The Personal Watercraft Industry Association believes the typical operating life of a personal watercraft rental is three years and approximately five to seven years for a privately owned vessel (PWIA 2002a).

Environmental groups, PWC users and manufacturers, and land managers express differing opinions about the environmental consequences of PWC use, and about the need to manage or to limit this recreational activity. Research conducted on the effects of PWC use is summarized below for water pollution, air pollution, noise, wildlife, shoreline vegetation and erosion effects, and health and safety concerns.

Water Pollution

The vast majority of personal watercraft in use today are two-stroke, non-direct-injection (carbureted) engines, which discharge as much as 30% of their fuel directly into the water (NPS 1999; CARB 1999). Hydrocarbons, benzene, toluene, ethyl benzene, and xylene (BTEX) are also released, as well as methyl tertiary-butyl ether (MTBE) in states that use this additive. In 1996, the Environmental Protection Agency promulgated a rule to control exhaust emissions from new marine engines, including outboards and personal watercraft. Emission controls provide for increasingly stricter standards beginning in model year 1996 (EPA 1997). The amount of pollution directly attributed to personal watercraft compared to other motorboats, and the degree to which personal watercraft affect water quality remains debatable. As noted in a report by the Oregon Department of Environmental Quality, every water body has different conditions (e.g., water temperature, air temperature, water mixing, motorboat use, and winds) that affect the pollutants' impacts (ODEQ 1999).

A recent study conducted by the California Air Resources Board consisted of a laboratory test designed to comparatively evaluate exhaust emissions from marine and PWC engines, in particular two- and four-stroke engines (CARB 2001). The results of this study showed a difference in emission (in some cases 10 times higher total hydrocarbons in two-stroke engines) between these two types of engines. An exception was air emissions of nitrogen oxides (NO_x) which was higher in four-stroke than in two-stroke engines. Concentrations of pollutants (MTBE and BTEX) in the tested water were consistently higher for two-stroke engines.

In 1996, the Environmental Protection Agency estimated an overall 52% reduction in hydrocarbon emissions from marine engines from present levels by 2010, and a 75% reduction by 2030, based on conversion of polluting machines. The 1997 EPA rule delayed implementation by one year (EPA 1996a, 1997). However, changing from two-stroke carbureted engines to two-stroke direct-injection engines may result in increases of airborne particulate-associated PAH (Kado et al. 2000). Polycyclic aromatic hydrocarbons (PAH), including benzo(a)pyrene, naphthalene, and 1-methyl naphthalene, are released

during the combustion of fuel, though some PAH are also found in unburned gasoline. Further research is needed to identify what impact this would have on PAH concentration in water.

Discharges of MTBE and PAH particularly concern scientists because of their potential to adversely affect the health of people and aquatic organisms. Scientists need to conduct additional studies on PAH (Allen et al. 1998) and on MTBE (NPS 1999), as well as long-term studies on the effect of repeated exposure to low levels of these pollutants (Asplund 2001).

At Lake Tahoe concern about the negative impact on lake water quality and aquatic life caused by the use of two-stroke marine engines led to at least 10 different studies relevant to motorized watercraft in the Tahoe Basin in 1997 and 1998. The results of these studies (Allen et al. 1998) confirm that (1) petroleum products are in the lakes as a result of motorized watercraft operation, and (2) watercraft powered by carbureted two-stroke engines discharge pollutants at an order of magnitude greater than do watercraft powered by newer technology engines (TRPA 1999).

On June 25, 1997, the Tahoe Regional Planning Agency adopted an ordinance prohibiting the "discharge of unburned fuel and oil from the operation of watercraft propelled by carbureted two-stroke engines" beginning June 1, 1999. Following the release of an environmental assessment in January 1999, this prohibition was made permanent.

PAH, as well as other hydrocarbon emissions, could potentially be reduced as new four-stroke and direct-injection engines replace older carbureted two-stroke engines. The conversion of carbureted two-stroke engines would be an important step toward substantially reducing petroleum related pollutants.

Some research shows that PAH, including those from personal watercraft emissions, adversely affect water quality via harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.

Air Pollution

Personal watercraft emit various compounds that pollute the air. In the two-stroke engines commonly used in personal watercraft, the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as volatile organic compounds (VOC), NO_x, particulate matter (PM), and carbon monoxide (CO). In areas with high PWC use, some air quality degradation likely occurs (EPA 1996a). Kado et al. (2000) found that two-stroke engines had considerably higher emissions of airborne particulates and PAH than four-stroke engines tested. It is assumed that the 1996 EPA rule concerning marine engines will substantially reduce air emissions from personal watercraft in the future (EPA 1996a).

PAH are released during the combustion of fuel, though some PAH are also found in unburned gasoline. Kado et al. 2000 indicated that changing from two-stroke carbureted engines to two-stroke direct-injection engines may result in increases of airborne particulate-associated PAH. The same study indicated that four-stroke engines have considerably less PAH emissions than two-stroke engines.[2] A subsequent study of airborne emissions indicated a potential health risk from toxic pollutants in areas of

2. It is noted that only one engine of each type (two-stroke carbureted, two-stroke direct injection, and four-stroke) was tested.

high concentration of exhaust from many engines, such as in an engine maintenance shop (Kado, Kuzmicky, and Okamoto 2001).

At Curecanti, personal watercraft do not congregate in areas where exhaust would be concentrated. As engines are converted from two-stroke to four-stroke types, the emissions of PAH are expected to decrease.

In August 2002, EPA proposed additional rules that would further reduce boating emissions. The proposal includes evaporative emission standards for all boats and would reduce emissions from fuel tanks by 80% (67 FR 157, August 14, 2002, pp. 53049-53115).

Noise

Personal watercraft-generated noise varies from vessel to vessel. No literature was found that definitively described scientific measurements of personal watercraft noise. Some literature stated that all recently manufactured watercraft emit fewer than 80 decibels (dB) at 50 feet from the vessel, while other sources attributed levels as high as 102 decibels without specifying the distance. None of this literature fully described the method used to collect noise data.

The National Park service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris et al. 2002). The results show that maximum personal watercraft noise levels at 25 meters (82 feet) ranged between 68 to 76 decibels on the A-weighted scale (dBA). Noise levels for other motorboat types measured during that study ranged from 65 to 86 decibels at 25 meters (82 feet).

Noise limits established by the National Park Service require vessels to operate at less than 82 dB at 82 feet from the vessel. Personal watercraft may be more disturbing than other motorized vessels because of rapid changes in acceleration and direction of noise. However, this regulation does not imply that there are no noise impacts from vessels operating below that limit. Noise impacts from PWC use are caused by a number of factors. Noise from human sources, including personal watercraft, can intrude on natural soundscapes, masking the natural sounds, which are an intrinsic part of the environment. This can be especially true in quiet places, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are non-motorized users (such as canoeists, sailing enthusiasts, people fishing or picnicking, and kayakers) can disrupt the “passive” experience of park resources and values.

Komanoff and Shaw (2000) note that the biggest difference between noise from personal watercraft and that from motorboats is that the former continually leave the water, which magnifies noise in two ways. Without the muffling effect of water, the engine noise is typically 15 dBA louder and the smacking of the craft against the water surface results in a loud “whoop” or series of them. With the rapid maneuvering and frequent speed changes, the impeller has no constant “throughput” and no consistent load on the engine. Consequently, the engine speed rises and falls, resulting in a variable pitch. This constantly changing sound is often perceived as more disturbing than the constant sound from motorboats.

PWC users tend to operate close to shore, to operate in confined areas, and travel in groups, making noise more noticeable to other recreationists (e.g., if identical boats emit 75 dB, two such boats together would be expected to emit 76 dB, 3 together would emit 77 dB, etc.) Motorboats traveling back and forth in one area at open throttle or spinning around in small inlets also generate complaints about noise levels; however, most motorboats tend to operate away from shore and navigate in a straight line, thus being less noticeable to other recreationists (Vlasich 1998).

Research conducted by the Izaak Walton League (IWL) indicates that one PWC unit can emit between 85 and 105 dB of sound, and that wildlife or humans located 100 feet away may hear sounds of 75 dB. This study also stated that rapid changes in acceleration and direction may create a greater disturbance and emit sounds of up to 90 dB (IWL 1999). Other studies conducted by the New Jersey State Police indicate that a PWC unit with a 100-horsepower (hp) engine emits up to 76 dBA, while a single, 175-hp outboard engine emits up to 81 dBA.

Sea-Doo research indicates that in three out of five distances measured during a sound level test, PWC engines were quieter than an outboard motorboat. Sea-Doo also found that it would take approximately four PWC units, 50 feet from the shore to produce 77 dBA, and it would take 16 PWC vessels operating at 15 feet from the shore to emit 83 dBA of sound, which is equal to one open exhaust boat at 1,600 feet from the shore. With new designs of personal watercraft, engines may be quieter. In response to public complaints, the PWC industry has employed new technologies to reduce sound by about 50% to 70% on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will reduce PWC noise, in association with improvements to engine technology (EPA 1996b). EPA research also indicated that one PWC unit operating 50 feet from an onshore observer emits a sound level of 71 dBA, and studies conducted using the Society of Automotive Engineers (2001) found that two PWC units operating 50 feet from the shore emit similar sound levels of about 74 dBA (PWIA 2000).

Most studies on the effects of noise on soundscapes and human receptors have focused on highway and airport noise. Komanoff and Shaw (2000) used the analytical approaches of these studies to perform a noise-cost analysis of personal watercraft. They concluded that the cost to beachgoers from personal watercraft noise was more than $900 million per year. The cost per personal watercraft was estimated to be about $700 per vessel each year or $47 for each 3-hour "personal watercraft day." They concluded that the cost per beachgoer was the highest at secluded lake sites, where beachgoers had a higher expectation of experiencing natural quiet and usually invested a larger amount of time and personal energy in reaching the area. However, because there are many more visitors to be affected at popular beaches, noise costs per personal watercraft were highest at crowded sites (*Drowning in Noise: Noise Costs of Jet Skis in America* [Komanoff and Shaw 2000]).

Wildlife Impacts

Few studies have specifically examined PWC effects on wildlife. Based on observations, some wildlife disturbances and harassment likely occurs, probably caused by speed, noise, and access. Nesting colonial birds are particularly susceptible to disturbance; however, the extent, duration, and magnitude of biological impacts because of PWC operations versus other motorboats remain unknown. Burger (2000) examined the related to common terns in relation to PWC use and other boats and noted that PWC users traveled faster and came closer to banks, resulting in more flight response in terns and contributing to lower reproductive success.

Shoreline Vegetation

The effects of personal watercraft on aquatic communities have not been fully studied, and scientists disagree about whether personal watercraft adversely impact aquatic vegetation. The majority of concern arises from the shallow draft of personal watercraft, allowing access to shallow areas that conventional motorboats cannot reach. Like other vessels, personal watercraft may destroy grasses that occur in shallow water ecosystems. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh vegetation and found that although the waves from personal watercraft are not different from those

generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Erosion Effects

Some studies have examined the erosion effects of personal watercraft waves and other studies suggest that personal watercraft may disturb sediments on river or lake bottoms and cause turbidity. Conflicting research exists concerning whether PWC-caused waves result in erosion and sedimentation. PWC-generated wave sizes vary depending on the environment, including weight of the driver, number of passengers, and speed. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh vegetation and found that, although the waves from personal watercraft are not different from those generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Health and Safety Concerns

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year PWC operators accounted for more than 41% of people injured in boating accidents. Personal watercraft operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998).

Increased PWC use in recent years has resulted in more concern about the health and safety of operators, swimmers, snorkelers, divers, and other boaters. A 1998 NTSB study revealed that while recreational boating fatalities have been declining in recent years, PWC-related fatalities have increased (NTSB 1998). Nationwide PWC accident statistics provided by the U.S. Coast Guard (USCG) supports the increase in PWC-related fatalities (see table 2) however, since a peak of 84 PWC-related fatalities in 1997, accidents, injuries, and fatalities involving personal watercraft have decreased. The U.S. Coast Guard's Office of Boating Safety studied exposure data to assess boating risks. This method allows for a comparison between boat types based on comparable time in the water. Personal watercraft use ranked second in boat type for fatalities per million hours of exposure in 1998, with a 0.24 death rate per million exposure hours.

Since PWC operators can be as young as 12 in several states, accidents can involve children. The American Academy of Pediatrics (2000) recommends that no one younger than 16 operate personal watercraft. Some manufacturing changes on throttle and steering may reduce potential accidents. For example, on more recent models, Sea-Doo developed an off-power assisted steering system that helps steer during off-power as well as off-throttle situations. This system, according to company literature, is designed to provide additional maneuverability and improve the rate of deceleration (Sea-Doo 2001a).

PWC USE AND REGULATION AT CURECANTI NATIONAL RECREATION AREA

Volume of PWC Use

Approximately 1 million visitors use Curecanti's facilities annually. This figure includes visitors who pursue recreation activities on the reservoir and those who engage in other recreation opportunities.

TABLE 2: NATIONWIDE PWC ESTIMATES AND ACCIDENT STATISTICS

Year	Recreational Boats Owned*	PWC Owned*	Number of PWC in Accidents	Number of PWC Injuries	Number of PWC Fatalities	Number of All Boats Involved in Accidents	Percent of PWC Involved in Accidents
1987	14,515,000	N/A	376	156	5	9,020	4.2%
1988	15,093,000	N/A	650	254	20	8,981	7.2%
1989	15,658,000	N/A	844	402	20	8,020	10.5%
1990	15,987,000	N/A	1,162	532	28	8,591	13.5%
1991	16,262,000	305,915	1,513	708	26	8,821	17.2%
1992	16,262,000	372,283	1,650	730	34	8,206	20.1%
1993	16,212,000	454,545	2,236	915	35	8,689	25.7%
1994	16,239,000	600,000	3,002	1,338	56	9,722	30.9%
1995	15,375,000	760,000	3,986	1,617	68	11,534	34.6%
1996	15,830,000	900,000	4,099	1,837	57	11,306	36.3%
1997	16,230,000	1,000,000	4,070	1,812	84	11,399	35.7%
1998	16,657,000	1,100,000	3,607	1,743	78	11,368	31.7%
1999	16,773,000	1,096,000	3,374	1,614	66	11,190	30.2%
2000	16,965,000	1,078,400	3,282	1,580	68	11,079	29.6%
Total			**33,851**	**15,238**	**645**		

Source: USCG 2001.

N/A = not available.

*Estimates provided by the National Marine Manufacturers Association (USCG 2001).

Park staff believes PWC use has increased since 1995, and a registration survey mailed to vessel users requesting an annual permit revealed that in 2000, 0.69% of over 400 respondents were PWC users (NPS 2002d). Based on ranger observation, most PWC users are from Colorado. There has been an increase of at least 10% in visitors from the Front Range in the last three years. This increase is likely a result of increasing visitation and more stringent regulations in Front Range water recreation areas. Gunnison County also has a large number of summer residents from other states that visit the recreation area (NPS 2002c). Based on 2001 Colorado Division of Wildlife creel data, an estimated 14,635 boats used Blue Mesa Reservoir between May and September.

PWC Use Areas

Curecanti National Recreation Area includes Blue Mesa Reservoir, which was created with the completion of the Blue Mesa Dam. Blue Mesa Reservoir is comprised of three basins: Sapinero, Cebolla, and Iola as well as various arms. The basins are often referred to as the main body of the reservoir to distinguish activities there from activities in the arms.

The *General Management Plan* (NPS 1997) and *Superintendent's Compendium* (NPS 2002g) allowed personal watercraft and other watercraft to operate on the main body of the Blue Mesa Reservoir and lake arms with speed and zone restrictions.

Most flat-wake speed violations, involving personal watercraft as well as other types of motorized vessels, occur in the Elk Creek Marina, the Soap Creek Arm and at Dry Creek. Personal watercraft generally do not operate in flat-wake speed areas at the end of lake arms because the arms are narrow in width. On the main body of the reservoir, personal watercraft are widely distributed. In addition to the main body, high-use areas include the Iola Basin and Colorado State Highway 149 (Highway 149) areas.

Other locations where personal watercraft operate include Stevens Creek, Cebolla Basin, Soap Creek Arm, Bay of Chickens, and the main marina at Elk Creek. Motorized vessels with horsepower of 25 or less are permitted on Crystal or Morrow Point Reservoirs. No motorized vessels are permitted east of Beaver Creek (refer to map 1).

PWC use is limited to approximately 2 hours with a wetsuit because of cold-water temperatures and high afternoon winds. PWC use conflicts with both bank and boat fishermen from Dry Creek to Bay of Chickens.

Visitor Safety

Information was gathered from a voluntary survey of 185 visitors who requested vessel registration at Curecanti. Forty respondents indicated a lack of perceived problems with PWC use; 90 respondents recommended limits on the time and locations of PWC use; and 7 would open flat-wake speed areas to PWC use (NPS 2000d).

The number of boating accidents at Curecanti ranged from two to seven per year for 1998 through 2002. None of these incidents involved personal watercraft and they primarily resulted in property damage rather than personal injury. Most property damage resulted from grounding or wind-related swamping. Since 1996, one young child required hospitalization as a result of a PWC accident (NPS 2002c).

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives and must also resolve purpose of and need for action.

Using the park's authorizing memorandum of agreement, mandates and direction in the *General Management Plan* (NPS 1997) and the *Strategic Plan* (NPS 2001c), issues, and servicewide objectives, park staff identified the following management objectives relative to PWC use:

WATER QUALITY

- Manage PWC emissions that enter the water in accordance with NPS anti-degradation policies and goals.
- Protect plankton and other aquatic organisms from PWC emissions so that the viability of dependent species is conserved.
- Manage PWC emissions so that Curecanti National Recreation Area continues to meet state of Colorado drinking water standards.
- Manage PWC emissions so that the quality of water flowing into the river does not adversely affect the Colorado River cutthroat trout and other fish.
- Manage PWC emissions so that water does not adversely affect fish recruitment and survival.

AIR QUALITY

- Manage PWC activity so that PWC air emissions of harmful compounds do not appreciably degrade ambient air quality.

SOUNDSCAPES

- Manage noise from PWC use in affected areas so that visitors' health, safety, and experiences are not adversely affected.
- Protect birds, waterfowl, and other wildlife from the effects of PWC noise.

WILDLIFE AND WILDLIFE HABITAT

- Protect fish and wildlife including the bald eagle, great blue heron [park native species of special concern] and Gunnison sage grouse [park native species of special concern and federal candidate] and their habitats from PWC disturbances.
- Protect fish and wildlife from the adverse effects that result from the bioaccumulation of contaminants emitted from personal watercraft.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

- Protect threatened and endangered species, and species of special concern, and their habitats from PWC disturbances.

SHORELINE VEGETATION

- Manage PWC use to protect sensitive shoreline areas from PWC activity and access.
- Manage PWC use to protect sensitive shoreline areas (vegetation / erosion) from PWC activity and access.

VISITOR USE AND EXPERIENCE

- Minimize potential conflicts between PWC use and park visitors.
- Seek cooperation with state entities that regulate PWC use.
- Manage PWC use consistent with authorizing memorandum of agreement, and provide a wide range of recreational activities consistent with conservation of the natural and cultural values.

VISITOR CONFLICT AND VISITOR SAFETY

- Minimize or reduce the potential for PWC user accidents.

- Minimize or reduce the potential safety conflicts between PWC users and other water recreationists.

- Minimize or reduce the potential user conflicts between PWC users and shore and boat fishermen.

CULTURAL RESOURCES (SECTION 106)

- Manage PWC use and access to protect cultural and paleontological resources.

SOCIOECONOMICS

- Work cooperatively with concessioners and local businesses that rent or sell personal watercraft.

ENVIRONMENTAL JUSTICE

- Minimize disproportionate impacts on minority and low-income populations.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

- Provide a safe and healthful park environment for park visitors.

- Seek cooperation with state entities that regulate PWC use.

ISSUES AND IMPACT TOPICS

Issues associated with PWC use at Curecanti were identified during scoping meetings with NPS staff and as a result of public comments. Many of these issues were identified in the settlement agreement with the Bluewater Network, which requires that at a minimum, the effects of PWC use be analyzed for the following: water quality, air quality, soundscapes, wildlife and wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. Potential impacts to other resources were considered as well. The following impact topics are discussed in the "Affected Environment" chapter and analyzed in the "Environmental Consequences" chapter. If no impacts are expected, based on available information, then the issue was eliminated from further discussion, as explained in the "Issues Eliminated from Further Consideration" section.

WATER QUALITY

The vast majority of personal watercraft in use today are carbureted, two-stroke engines, which discharge as much as 30% of their fuel directly into the water (NPS 1999; CARB 1999). Hydrocarbons, including benzene, toluene, ethyl benzene, and xylene; and PAH are released, as well as MTBEs. These discharges have potential adverse effects on water quality.

Some research shows that PAH, including those from personal watercraft emissions, adversely affect water quality via harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). Curecanti is located at a high altitude, has clear water and receives an abundance of solar input. These environmental factors, in combination with PAH, can affect aquatic life and, ultimately, aquatic food chains. The primary concern is in shallow water ecosystems.

Curecanti is part of the Wayne N. Aspinall Storage Unit and is one of four units that comprise the Upper Colorado River Storage Project. The Aspinall Storage Unit provides water for many purposes to downstream users including power generation and water storage. Municipalities downstream from Curecanti may divert water from the Gunnison Tunnel for local exchange.

Effluent from Crystal Dam flows into the Gunnison River at the Black Canyon where the Colorado River cutthroat trout, state species of concern, occurs. PWC emissions may have an effect on fish recruitment and survival in Blue Mesa Reservoir.

AIR QUALITY

Pollutant emissions, particularly NO_x and HC from personal watercraft, may adversely affect air quality. These compounds react with sunlight to form ozone. To the extent that nitrogen loading in the air contributes to the nutrient loading in the water column, PWC use adversely affects water quality.

SOUNDSCAPES

Noise limits established by the National Park Service require vessels to operate at less than 82 dB at 82 feet.

Some research suggests that personal watercraft have a greater impact on waterfowl and nesting birds because of their noise, speed, and ability to access shallow-water areas more readily than other types of watercraft. This may force nesting birds to abandon eggs during crucial embryo development stages and flush other waterfowl from habitat, causing stress and associated behavior changes. At Curecanti, these disturbances may affect the Gunnison sage grouse (species of concern and federal candidate species) when personal watercraft legally operate and the great blue heron (park native species of special concern) if personal watercraft operate in areas illegally. Collisions with waterfowl and wildlife may also be of concern. Great blue herons typically nest and roost in groves of large trees along reservoirs, rivers, and irrigation canals. Nesting areas for great blue heron occur along the Gunnison River partially within Curecanti boundaries.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that PWC use impacts wildlife through interruption of normal activities, alarm or flight; avoidance and displacement of habitat; and effects on reproductive success. This is thought to be caused by a combination of PWC speed, noise and ability to access sensitive areas, especially in shallow-water depths. Literature suggests that personal watercraft can access sensitive shorelines, disrupting riparian habitat areas critical to wildlife.

Deer, elk and bighorn sheep occur mostly in terrestrial habitat adjacent to the lake arms. There is potential for the noise to reverberate if personal watercraft are running fast, but the lake arms have flat-wake speed

restrictions to prevent these noise impacts (see *General Management Plan* [NPS 1997] for additional information). The potential exists for noise impacts on smaller wildlife such as squirrels, skunks, and porcupines that are in areas close to the reservoir.

Animals also could be affected when PWC users are operating illegally in areas where flat-wake speed restrictions do apply.

THREATENED AND ENDANGERED, AND SPECIAL CONCERN SPECIES

A variety of state and federally listed and park sensitive species are found at Curecanti. The Colorado River cutthroat trout is found in the Gunnison River, downstream of Crystal Reservoir and the Crystal Dam. The species does not occur in Sapinero, Cebolla or Iola Basins, which comprise Blue Mesa Reservoir. Water from Curecanti flows into the Gunnison River and could potentially affect this species. However, PWC use occurs only on Blue Mesa Reservoir. Morrow Point and Crystal Reservoirs are located between Blue Mesa and the Gunnison River, providing substantial dilution for PWC pollutant emissions prior to reaching the river.

In some areas personal watercraft could cause harm to the Colorado River cutthroat trout, (state species of concern), nesting great blue heron (park native species of special concern), the Gunnison sage grouse (federal candidate species), and two astragalus species, (state imperiled plants), because of the machine's operational characteristics and users' ability to access areas of species habitat.

The Gunnison sage grouse, a federal candidate species, is not a waterfowl but nests close to water at the Stevens Creek Campground. A historical lek (mating) site for the Gunnison sage grouse occurs on the south side of the highway at the Stevens Creek Campground. Lek habitat for the Gunnison sage grouse consists of open areas within sagebrush vegetation with good visibility (for predator detection) and acoustics (for transmission of male display sounds) (USFWS 2000). The great blue heron, a park native species of special concern, could be affected if visitors were engaging in illegal PWC use. Bald eagles are in the park but do not nest around the reservoir during the months when personal watercraft are in use.

Two astragalus species, the skiff milkvetch (listed by the state as critically imperiled) and the Gunnison milkvetch (listed by the state as imperiled), occur in dry upland areas that could be accessed on the south shore around Middle Bridge. These plants are also accessible by other means.

SHORELINE VEGETATION

Personal watercraft are able to access areas such as shallow waters where most other watercraft cannot go, which may result in disturbance of sensitive plant species. In addition, personal watercraft may land on the shoreline allowing visitors to access areas where sensitive vegetation and plants species exist. However, these species are also easily accessible by vehicles and other vessels.

When the reservoir is at full pool, wake from personal watercraft and other watercraft could affect shoreline vegetation. However, gusty winds are more likely to cause more erosion than PWC use. There are no sensitive shoreline plant species although there are dry upland species that visitors could access once they disembark from their personal watercraft.

VISITOR EXPERIENCE

Some research suggests that personal watercraft are viewed by some segments of the public as a 'nuisance' due to their noise, speed and overall environmental effects, while others believe personal watercraft are no different than other watercraft and that users have a "right" to enjoy the sport.

Some states and local governments have taken action, or are considering taking action, to limit, ban and otherwise manage PWC use. While the park may be 'exempt' from these local actions, consistency with state and local plans must be considered. The state of Colorado has PWC regulations that provide guidelines for PWC operation and safety at Curecanti.

The *General Management Plan* (NPS 1997) discusses Curecanti National Recreation Area's mandate "for public use and enjoyment." PWC management may affect the enhancement of recreational opportunities or cause changes in the methods and types of recreational activities occurring within the park (NPS 1997).

VISITOR CONFLICTS AND SAFETY

The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of the registered "vessels" in the United States but were involved in 36% of all boating accidents. In part, this is believed to be a "boater education" issue (for example, inexperienced riders lose control of the craft) and also a function of the PWC operation, that is, no brakes or clutch. When drivers let up on the throttle to avoid a collision, manual steering becomes difficult.

Due to their ability to reach speeds in the 60 mph range and their ability to access shallow-draft areas, personal watercraft can create wakes that pose a conflict for both shore and boat fishermen and a safety hazard to other users such as canoeists, kayakers and windsurfers. The biggest PWC infraction at Curecanti is ignoring flat-wake speed zones. Conflicts occur in cliff diving areas west of Dry Creek and near U.S. 50 near Bay of Chickens. The superintendent has received a few complaints about PWC/fishermen conflicts. While no PWC accidents have been reported in the last five years, the share of PWC citations is disproportionately large. During the five-year period PWC account for less than 6% of the total watercraft but over 20% of all watercraft citations.

Managing personal watercraft under a more restrictive strategy may require additional park staff to enforce standards and limits.

CULTURAL RESOURCES (SECTION 106)

Curecanti National Recreation Area has archeological and paleonotological resources listed on or potentially eligible for listing on the National Register of Historic Places (NRHP) that may be affected by PWC use. Uncontrolled visitor access by personal watercraft, as well as other vessels and vehicles, may affect the resources since riders and drivers are able to access, beach, or launch in the areas that might otherwise be inaccessible. Personal watercraft operating at high rates of speed could create a wave action that results in shoreline erosion, thus exposing resources to increased damage.

SOCIOECONOMICS

National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001 (refer to table 1). Statewide PWC registrations have also decreased between 2001 and 2002.

Personal watercraft can be rented or bought in Grand Junction. One company in Montrose sells personal watercraft, which accounted for 1% of their business in 2001 and 2002. The company does not rent personal watercraft. Most visitors arrive at Curecanti with personally owned vessels.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

PWC use may require additional park staff to enforce standards, limits, or closures because of increased accident rates and visitor conflicts.

CONFLICT WITH STATE AND LOCAL ORDINANCES AND POLICIES REGARDING PWC USE

Some states and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While the park may be exempt from these local actions, consistency with state and local plans must be evaluated.

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

Economically Disadvantaged or Minority Populations (Executive Order 12898) – Residents of Gunnison County include low-income populations. However, these populations would not be particularly or disproportionately affected by continuing or discontinuing PWC use. Other areas near the park are available to all PWC users. There are no small business owners in the Curecanti area that rent personal watercraft as a primary source of income. This issue was dismissed from further analysis for the following reasons:

- Personal watercraft are used by a cross section of ethnic groups and income levels.
- Other areas are available and open to personal watercraft and are used by all ethnic groups.
- NPS actions would not disproportionately affect minority or low-income populations.
- Any NPS actions to limit PWC use would not displace PWC use to low-income or ethnically sensitive areas.

Cultural Landscapes from PWC Use and Access to Sites – While no cultural landscapes have been identified, surveyed, or documented with Curecanti National Recreation Area to date, it is possible that potentially eligible landscapes could be either outside the study area or in areas already experiencing heavy visitor use from both land and water vehicles, the impacts (if any) resulting from the proportionately low number of PWC users would be extremely difficult to distinguish or quantify.

Historic Structures from PWC Use and Access to Sites – Five structures are currently listed on the fiscal year (FY) 1999 National Park Service List of Classified Structures (LCS) for Curecanti. Given that the majority of historic structures within the park are either located outside the study area or in areas already

experiencing heavy visitor use from land and water vehicles, the impacts (if any) resulting from the proportionately low number of personal watercraft would be extremely difficult to distinguish or quantify.

Museum Collections – The scope of collections for Curecanti National Recreation Area includes archeological objects collected within the park boundaries, and historic objects and archival material related to the Denver and Rio Grande Western narrow gauge railroad and to the Town of Cimarron. Data from the 2000 Collections Management Report indicates that total objects and specimens number 144,284 with total archival documents of 27,584. These items are managed as provided for in *Director's Order #24: NPS Museum Collections Management and the NPS Museum Handbook*. While the collection is maintained at Cimarron, which is within the project area, the impacts (if any) resulting from the proportionately low number of personal watercraft would be extremely difficult to distinguish or quantify.

Ethnographic / Sacred Sites – Ethnographic resources are defined as the natural and cultural materials, features, and places that are linked by a subject community to the traditional practices, values, beliefs, history, and/or ethnic identity of that community. In 2002, the NPS Intermountain Support Office, in cooperation with the park, sought to summarize American Indian tribal affiliation within and surrounding the park for a congressional mandated special resource protection study and environmental impact statement. Historical records document Ute affiliation with the region from western Colorado and into eastern Utah. The Uncompaghre (or Taviwach) band also has a historic affiliation with this area. Other tribes identified with possible cultural affiliation include the Cheyenne, Comanche, Hopi, Navajo, Apache, White Mesa Ute (comprised of Paiute and Ute), Paiute, and the San Juan Southern Paiute (NPS 2002a).

While ethnographic resources or sacred sites have not yet been formally evaluated for their status as traditional cultural properties / sacred sites, it is possible that potentially eligible resources could be either outside the study area or in areas already experiencing heavy visitor use from both land and water vehicles, the impacts (if any) resulting from the proportionately low number of PWC users would be extremely difficult to distinguish or quantify.

Wetlands – Wetlands make up a very small portion of overall community types and are located primarily along stream courses, including the Gunnison River and associated tributaries. The Cooper Ranch/Neversink area along the Gunnison River, above Blue Mesa Reservoir, is unique and valuable due to riparian and wetland communities. There are no substantial wetland areas in areas of PWC use or areas that are easily accessible to personal watercraft. Personal watercraft can access the Cooper Ranch/Neversink wetlands via the Gunnison River above Beaver Creek, however, this access is illegal.

Floodplains – The level of PWC use and associated PWC activities identified in each alternative would have no adverse impacts on floodplains. No development is proposed in the alternatives; thus, no flooding would result as a result of PWC use and cause impacts to human safety, health, or welfare.

Prime and Unique Agricultural Lands – No prime and unique agricultural farmland exists in the vicinity of areas that would be affected by PWC use.

Energy Requirements and Natural or Depletable Resource Requirements – PWC operation requires the use of fossil fuels. While PWC use could be limited or banned within this park unit, no alternative considered in this environmental assessment would affect the number of personal watercraft used within the region or the amount of fuel that is consumed. The level of PWC use considered in this environmental assessment is minimal. Fuel is not now in short supply, and PWC use would not have an adverse effect on continued fuel availability.

RELATIONSHIP TO OTHER PLANS, POLICIES AND ACTIONS

The following plans, policies, and actions could affect the alternatives being considered for personal watercraft use. These plans and policies are also considered in the analyses of cumulative effects. The current *General Management Plan* (NPS 1997) for Curecanti gives direction for appropriate visitor activities and facilities at specific places in the park, called resource opportunity areas.

PARK POLICIES, PLANS, AND ACTIONS

- Elk Creek Marina Improvement: In conjunction with the concessioner and the NPS Intermountain Region concession staff, the Park is taking the lead to make changes to the slip configuration and gas and electric services at Elk Creek Marina. These improvements could result in increased visitation.

- In response to a congressional request, a resource protection study is currently being prepared by the National Park Service that will identify and recommend a variety of practical alternatives and tools to protect resource values and the character of the land as provided for in section 8 of the Black Canyon of the *Gunnison National Park and Gunnison Gorge Conservation Act*.

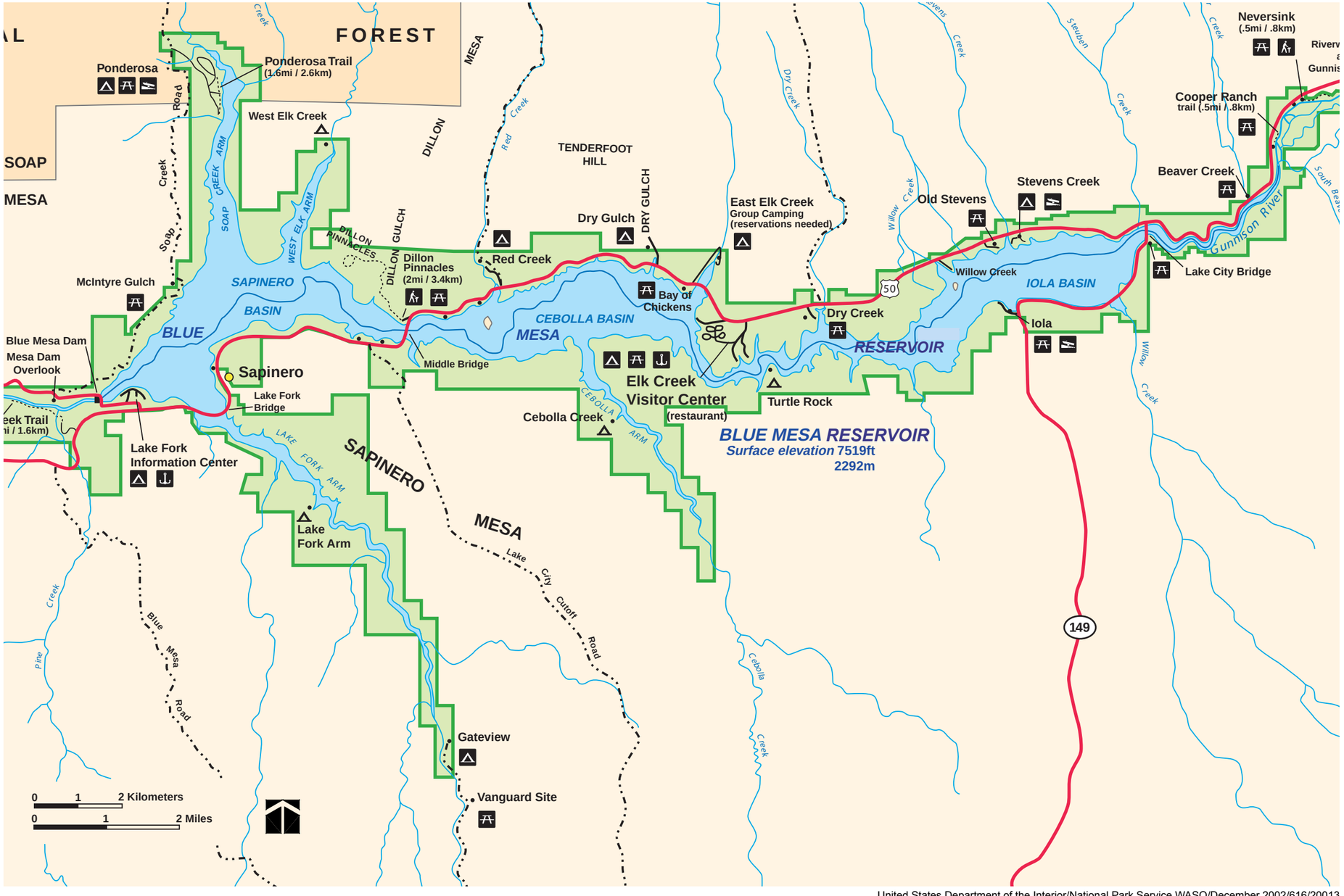
LOCAL OR STATE POLICIES, PLANS, OR ACTIONS

Tomichi Creek Development: Gunnison contractor's development proposal could increase City of Gunnison population by an estimated 33%.

Curecanti National Recreation Area

Colorado

Location Map

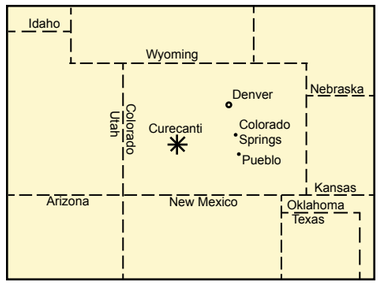


United States Department of the Interior/National Park Service WASO/December 2002/616/20013

LEGEND

- Unpaved road (may be closed in winter)
- Overlook
- Former river channel
- Hiking trail (lengths listed are one-way)
- National Park Service Land
- Buffer zone
- Flat wake zone
- Speed restrictions
- Picnic area
- Boat launch
- Interpretive trail
- Public campground
- Campsite: boat-in
- Marina

VICINITY



This page to be removed

Back of MAP 1

ALTERNATIVES

All alternatives must be consistent with the purpose and significance of the Curecanti National Recreation Area, and they must meet the purpose of and need for action, as well as the objectives for the project. Three alternatives are described in this section.

In accordance with NEPA, the alternatives analyzed in this document are the result of agency and public scoping input, and as stipulated in the settlement agreement between the Bluewater Network and the National Park Service. The action alternatives address reinstated PWC use under a special regulation with new management strategies and mitigation measures. Under the no-action alternative, PWC use would not be reinstated because the National Park Service would not take action to draft a special regulation to allow PWC use.

Table 3 summarizes the alternatives being considered, table 4 summarizes the impacts of each alternative, and table 5 analyzes how the alternatives meet the project objectives (as identified in the "Purpose and Need" chapter). These three tables are located at the end of this chapter.

ALTERNATIVE A: REINSTATE PWC USE UNDER A SPECIAL REGULATION AS PREVIOUSLY MANAGED

PWC use would be reinstated on Blue Mesa Reservoir through a special regulation and would be managed consistent with management strategies, as outlined in the *Superintendent's Compendium* (NPS 2002g) and in applicable state regulations in effect until November 6, 2002. The following summarizes the provisions of alternative A. Refer to the alternative A map (map 2) for specific locations mentioned in the text.

Areas of Use. PWC use would be reinstated in all locations of the recreation area where it was allowed until November 6, 2002. As prescribed by Curecanti's *General Management Plan* (NPS 1997) and the *Superintendent's Compendium* (NPS 2002g), PWC use would occur in areas of Blue Mesa Reservoir and portions of the lake arms. Areas appropriate for PWC use would include Sapinero, Cebolla and Iola Basins; Bay of Chickens; Dry Creek; Elk Creek; the Highway 149 area; and Lake Fork, Soap Creek, and West Elk arms.

Operation of all motorized watercraft would continue to be unacceptable in areas east of Beaver Creek within the Gunnison River Canyon and in the area downstream from the East Portal diversion dam. The following areas would remain closed to all boating, including personal watercraft, and shoreline entry:

- Blue Mesa Dam downstream for 225 yards
- Morrow Point Dam downstream for 130 yards
- Crystal Dam downstream for 700 yards
- East Portal diversion dam upstream for 60 yards

Personal watercraft would continue to abide by the horsepower limitations (25 hp) in Morrow Point and Crystal Reservoirs.

Speed Zone and Wake Restrictions. The state of Colorado regulations allow motorized vessels such as personal watercraft to operate at speeds up to 40 mph, except where restricted.

The state of Colorado defines "wake" to mean a movement of the water created by a boat underway, great enough to disturb a boat at rest, but under no circumstances would a boat underway exceed 5 mph while in a posted no-wake area. On bodies of water within the state of Colorado, the term "above a no-wake speed" means operating a vessel at such speed as to create a wake. The current draft of 36 CFR 3 defines "flat-wake speed" as minimal disturbance of the water by a vessel in order to prevent damage or injury.

At Curecanti, the following areas would remain flat-wake speed areas:

- The area upstream from Lake City Bridge to Beaver Creek
- The most inland and narrow portions of Soap Creek Arm, West Elk Arm, Lake Fork Arm, and Cebolla Arm
- Narrow waterways off the Bay of Chickens and Dry Creek
- Elk Creek and Lake Fork Marinas and Iola, Stevens Creek boat launch area

Monitoring and Sampling. Existing monitoring program would continue to measure resource changes and impacts. Resources to be monitored would include, but would not be limited to, water quality, shoreline erosion, Gunnison sage grouse, bird presence and abundance, and visitor use patterns.

Launch Restrictions. All designated launch areas on Blue Mesa Reservoir (developed and unimproved) would remain open to PWC use. Personal watercraft would be allowed to land on any shoreline at Blue Mesa Reservoir.

Equipment and Emission Restrictions. As noted in the Introduction, the Environmental Protection Agency promulgated a rule to control exhaust emissions from new marine engines, including outboards and personal watercraft. Emission controls provide for increasingly stricter standards beginning in model year 1999 (EPA 1996a, 1997). Under this alternative, it is assumed that PWC carbureted engines would be converted to cleaner two-stroke or four-stroke engines in accordance with the Environmental Protection Agency's Rule (40 CFR Parts 89-91, "Air Pollution Control; Gasoline Spark-Ignition and Spark-Ignition Engines, Exemptions; Rule, 1996). It is the responsibility of he PWC industry to meet these regulations, not the responsibility of individual owners. However, as owners replaced their personal watercraft, cleaner engines that comply with EPA regulations would be available for purchase.

Operating Restrictions. All state and federal watercraft laws and regulations would continue to be enforced, including regulations that address reckless or negligent operation, excessive speed, hazardous wakes or washes, hours of operation, age of driver and distance between vessels. Specifically, the state requires that vessels passing within 150 feet of any swimming area, moored vessel, person on shore engaged in fishing, or person in a vessel engaged in servicing buoys or markings, reduce speed in order to prevent wash or wake of the vessel from causing damage or inconvenience. In addition, the state requires all riders to wear personal floatation devices and a lanyard cutoff switch, if installed.

Riders on waters within the state of Colorado must be at least 16 years old. However, children 14 and 15 years of age may operate a personal watercraft after completing a mandatory boat safety course. Operation of personal watercraft from one-half hour after sunset to one-half hour before sunrise is prohibited. State regulations do not allow personal watercraft to exceed 40 mph except during authorized race events and except for patrol vessels operating in emergencies.

Additionally, Colorado state law defines rider operation as careless and reckless when:

- jumping a vessel's wake at an unsafe distance;
- jumping another vessel's wake when visibility around the vessel is obstructed;
- weaving unsafely through vessel traffic; or
- operating at such a speed and proximity to another vessel that either vessel must swerve or cut speed to avoid a collision.

ALTERNATIVE B: REINSTATE PWC USE UNDER A SPECIAL REGULATION WITH ADDITIONAL MANAGEMENT PRESCRIPTIONS (PREFERRED ALTERNATIVE)

The launch restrictions, operating restrictions, and engine conversion assumptions for personal watercraft would be the same as described under alternative A. In addition, the following management actions would be implemented under this alternative.

Areas of Use. In addition to the areas of use outlined in alternative A, a 100-foot buffer zone would be created along the south shore of Blue Mesa Reservoir that stretches from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge for soundscape, cultural resource, and wildlife protection as well as to prevent erosion. A second 100-foot buffer zone would be established at the Stevens Creek campground for the protection of an active Gunnison sage grouse lek and nesting area. A buffer zone would mitigate potential noise impacts from PWC use and associated shoreline use during the lek and nesting season (mid-March – July). Buffer areas would be zoned as flat-wake speed areas (map 3).

Speed Zone and Wake Restrictions. In addition to the speed zones outlined in alternative A, areas from the mouth of the lake arms on Blue Mesa Reservoir upriver to the point where noise or speed impacts visitor safety, wildlife, or soundscapes would be managed for no-wake or idle speeds within 150 feet of another boat, a person in or floating on the water, a water skier (except those being towed), shore fisherman, a launching ramp, a dock or a designated swimming area. Flat-wake speed zones would be established from this point upriver to river inlet.

Monitoring and Sampling. Existing resource conditions and a monitoring program would be established to measure resource changes and impacts as a result of PWC use. Resources to be monitored would include, but would not be limited to, water quality, shoreline erosion, Gunnison sage grouse, bird presence and abundance, and visitor use patterns. (Monitoring requirements would be adjusted by the park based on the potential for PWC-related impacts.)

Education. A voluntary user education program would be established and include interpretive talks, on-site bulletins, brochures to PWC registrants, and visitors who rent personal watercraft.

NO-ACTION ALTERNATIVE: ALLOW NO PWC USE

PWC use would not be reinstated and the National Park Service would not take action to draft a special regulation to reinstate PWC use after 2002 (map 4).

THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is defined by the Council on Environmental Quality (CEQ) as the alternative that best meets the following criteria or objectives, as set out in Section 101 of the *National Environmental Policy Act*:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, whenever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

This discussion also summarizes the extent to which each alternative meets Section 102(1) of the *National Environmental Policy Act*, which asks that agencies administer their own plans, regulations, and laws so that they are consistent, to the fullest extent possible, with the policies outlined above.

Alternative A would satisfy the majority of the six requirements detailed above; however, alternative A would not ensure for safe, healthful, productive, and aesthetically pleasing surroundings by allowing PWC use in areas frequented by passive outdoor recreationists (passive recreationists are not as numerous – see *General Management Plan* [NPS 1997]). Alternative A would not attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences because of the potential impacts of PWC use to visitor experiences, natural resources, and other opportunities in the national recreational area. For this reason, alternative A is not preferred from an environmental perspective.

Alternative B would have impacts on the national recreational area's natural resources similar to those under alternative A. In the long term, this alternative would help visitors enjoy a beneficial use by allowing access to national recreation area amenities by PWC users while accommodating passive outdoor recreationists and meeting resource management objectives. This alternative would accommodate recreational opportunities for visitors while protecting sensitive natural resources. Alternative B is designed to meet NPS's general prohibition on PWC use for the protection of park resources and values while providing recreational opportunities for PWC users.

The no-action alternative would ensure a safe, healthful, productive, and aesthetically and culturally pleasing area for visitors to access without the threat of PWC users introducing noise and safety concerns. The no-action alternative would attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences by removing the PWC use from the national recreation area entirely. However, the no-action alternative would not

maintain an environment that supports diversity and variety of individual choice, nor would it achieve a balance between population and resource use that permits a wide sharing of amenities.

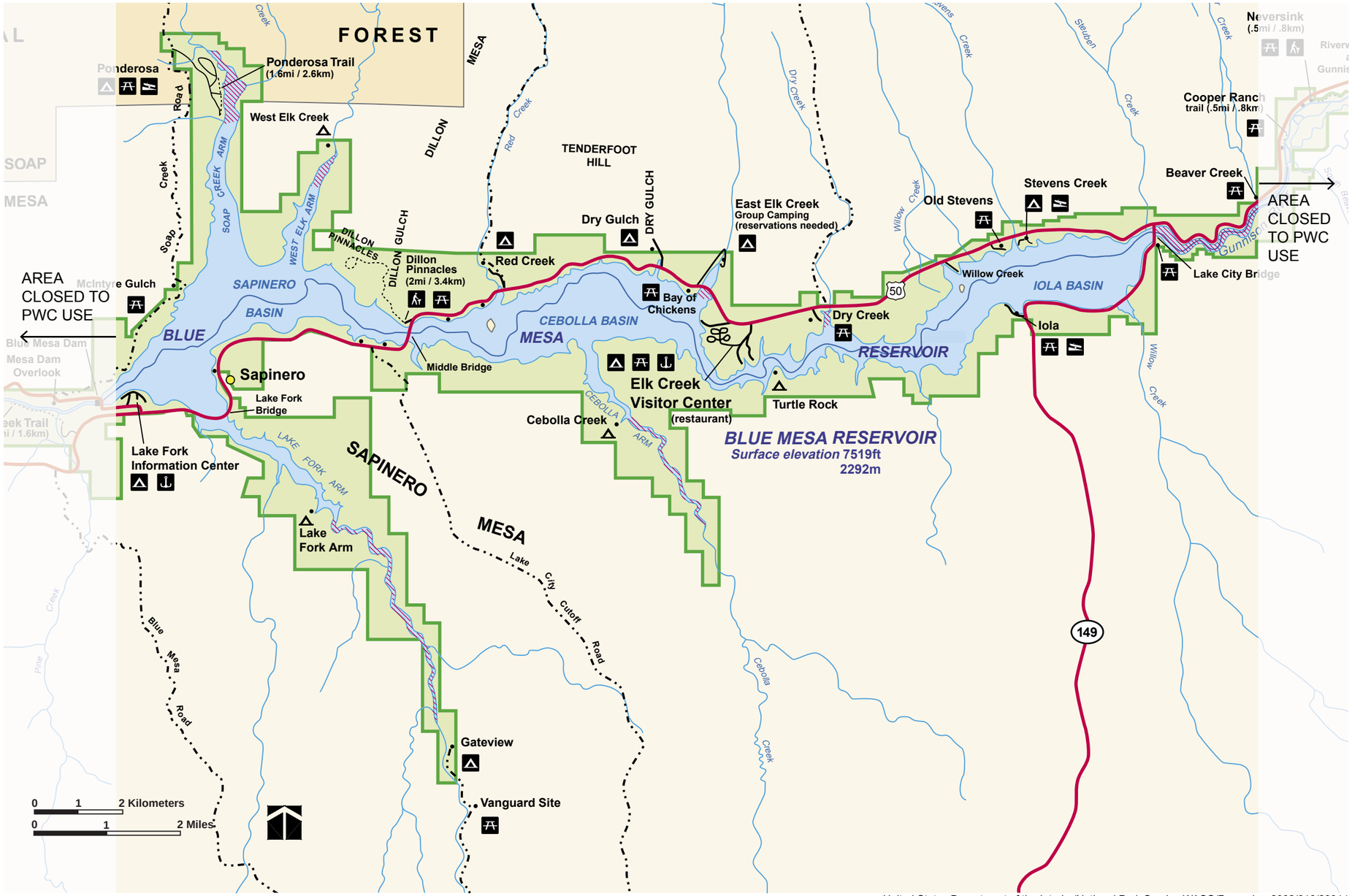
Based on the analysis prepared for PWC use at Curecanti National Recreation Area, alternative B is considered the environmentally preferred alternative by best fulfilling park responsibilities as trustee of sensitive habitat; by ensuring safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and by attaining a wider range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

Curecanti National Recreation Area

Colorado

Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Use would continue in the flat water areas of Blue Mesa Reservoir and portions of the lake arms as prescribed in the general management plan and the Superintendent's Compendium.

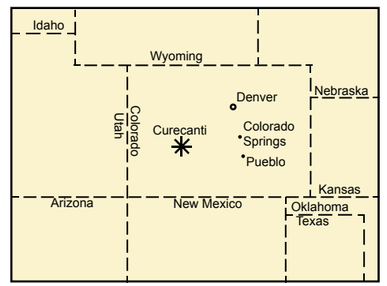


United States Department of the Interior/National Park Service WASO/December 2002/616/20014

LEGEND

- Unpaved road (may be closed in winter)
- Former river channel
- Land
- Flat wake zone
- Picnic area
- Public campground
- Boat launch
- Campsite: boat-in
- Overlook
- Hiking trail (lengths listed are one-way)
- Buffer zone
- Speed restrictions
- Interpretive trail
- Marina

VICINITY



This page to be removed
back of Map 2

Curecanti National Recreation Area

Colorado

Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Same as alternative A, with 100-foot buffer zone along south shore of the main lake body, 100-foot buffer zone along northern shore of main body and speed restriction zones from mouth of lake arms.

AREA CLOSED TO PWC USE

AREA CLOSED TO PWC USE

FOREST

MESA

DILLON

TENDERFOOT HILL

Ponderosa

Ponderosa Trail (1.6mi / 2.6km)

West Elk Creek

Road

Soap Creek

SOAP CREEK ARM

WEST ELK ARM

DILLON PINNACLES

DILLON GULCH

Dillon Pinnacles (2mi / 3.4km)

Red Creek

Dry Gulch

DRY GULCH

East Elk Creek Group Camping (reservations needed)

Bay of Chickens

Dry Creek

Willow Creek

Old Stevens

Stevens Creek

Beaver Creek

Cooper Ranch trail (.5mi / .8km)

Lake City Bridge

IOLA BASIN

Iola

RESERVOIR

50

SAPINERO BASIN

BLUE MESA

CEBOLLA BASIN

Mcintyre Gulch

Blue Mesa Dam

Mesa Dam Overlook

Sapinero

Lake Fork Bridge

Middle Bridge

Elk Creek Visitor Center (restaurant)

Turtle Rock

Cebolla Creek

CEBOLLA ARM

BLUE MESA RESERVOIR

Surface elevation 7519ft

2292m

Lake Fork Information Center

LAKE FORK ARM

SAPINERO MESA

Lake Fork Arm

Lake City Cutoff Road

Blue Mesa Road

Gateview

Vanguard Site

Cebolla Creek

149

0 1 2 Kilometers

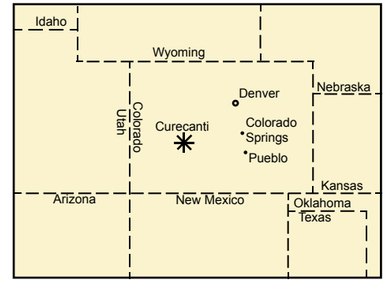
0 1 2 Miles

United States Department of the Interior/National Park Service WASO/December 2002/616/20015

LEGEND

- Unpaved road (may be closed in winter)
- Overlook
- Former river channel
- Hiking trail (lengths listed are one-way)
- National Park Service Land
- Buffer zone
- Flat wake zone
- Speed restrictions
- Picnic area
- Boat launch
- Interpretive trail
- Public campground
- Campsite: boat-in
- Marina

VICINITY



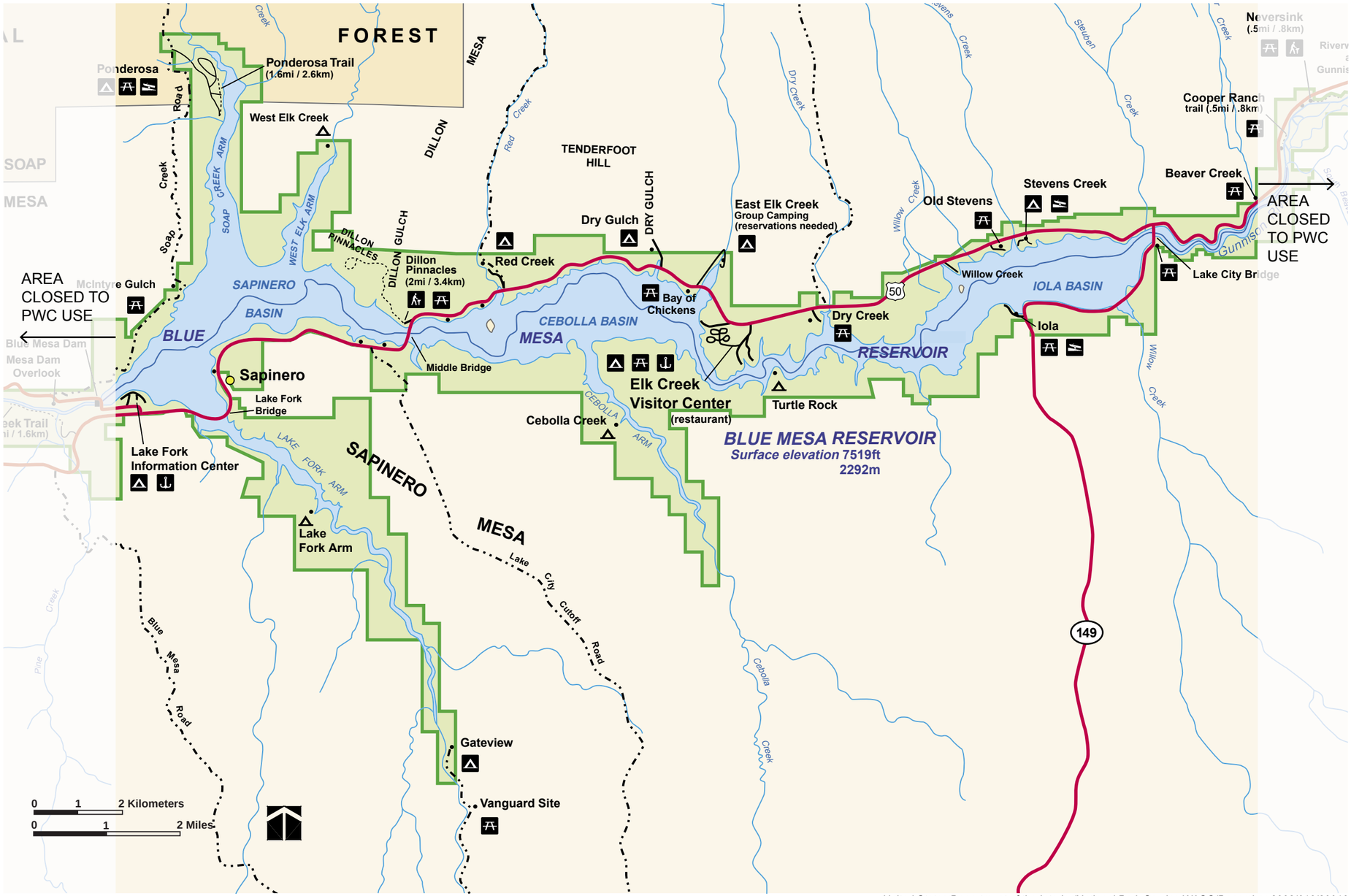
This page to be removed
back of Map 3

Curecanti National Recreation Area

Colorado

No-Action Alternative: Allow No PWC Use

Continue present management actions, including geographical restrictions as prescribed in the general management plan and the Superintendent's Compendium. The National Park Service would take no further action to adopt special regulations retaining PWC use, which would result in a ban on PWC use at the recreation area beginning in November 2002.

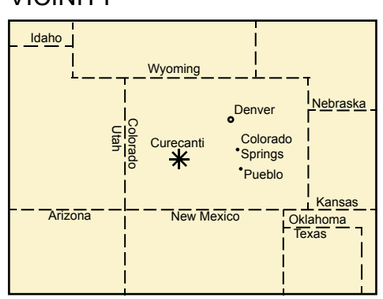


United States Department of the Interior/National Park Service WASO/December 2002/616/20016

LEGEND

- Unpaved road (may be closed in winter)
- Former river channel
- National Park Service Land
- Flat wake zone
- Overlook
- Hiking trail (lengths listed are one-way)
- Buffer zone
- Speed restrictions
- Picnic area
- Boat launch
- Interpretive trail
- Public campground
- Campsite: boat-in
- Marina

VICINITY



This page to be removed
back of Map 4

TABLE 3: SUMMARY OF ALTERNATIVES

Elements	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Areas of Use			
	Reinstate PWC use in areas of Blue Mesa Reservoir and portions of lake arms. Locations where allowed include Sapinero, Cebolla and Iola Basins; Bay of Chickens; Dry Creek; Elk Creek; the Highway 149 area; Soap Creek, Lake Fork, and West Elk arms.	Reinstate PWC use in same locations as alternative A.	No PWC use.
Location Restrictions	No motorized vessel operation east of Beaver Creek and downstream from East Portal diversion dam, Blue Mesa Dam downstream 225 yards and upstream 500 yards, Morrow Point Dam downstream 130 yards, Crystal Dam downstream 700 yards, and East Portal upstream 60 yards. Horsepower limitations (25 hp) remain in Morrow Point and Crystal Reservoirs.	In addition to alternative A restrictions, 100-foot buffer along south shore from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge, and 100-foot buffer along north shore of main body at Stevens Creek.	No PWC use.
Speed Zone and Wake Restrictions			
	The most inland and narrow portions of Soap Creek, Lake Fork, West Elk and Cebolla arm, and narrow waterways off the Bay of Chickens and Dry Creek, would remain as flat-wake speed areas. The area upstream from Lake City Bridge to Beaver Creek would remain a flat-wake speed area in addition to the Elk Creek, Lake Fork, Iola, and Stevens Creek boat launch areas. The state of Colorado regulations allow motorized vessels such as personal watercraft to operate at speeds up to 40 mph, except where restricted.	In addition to alternative A restrictions, from mouth of the lake arms upriver to the point where noise or speed impact visitor safety, wildlife or soundscapes would be managed for wakeless or idle speeds. Flat-wake zone from this point upriver to inlet. Buffer zones would be zoned for flat-wake speed.	No PWC use.
Launch Restrictions			
	All designated launch areas on Blue Mesa (developed and unimproved) remain open to PWC use.	In addition to alternative A restrictions, 100-ft buffer south shore main body from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge 100-ft buffer on northern shore of main body at Stevens Creek.	No PWC launching or retrieval permitted.
Equipment and Emissions Restrictions	PWC two-stoke engines would be converted to cleaner four-stroke engines in accordance with the Environmental Protection Agency's assumptions (40 CFR Parts 89-91, "Air Pollution Control; Gasoline Spark-Ignition and Spark-Ignition Engines, Exemptions; Rule, 1996). Curecanti National Recreation Area would not accelerate this conversion from two-stroke to four-stroke engines.	Same as alternative A.	No PWC use.
Operating Restrictions			
Age Restrictions	In accordance with Colorado State law, operators must be at least 16, children 14 and 15 may operate personal watercraft after completing mandatory boat safety course.	Same as alternative A.	Not applicable.

Elements	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Flotation Devices	According to state regulations, require all PWC riders to wear U.S. Coast Guard-approved personal floatation devices of the appropriate size.	Same as alternative A.	No PWC use.
Lanyard-Cutoff	The state requires use of lanyard cutoff switch, if installed.	Same as alternative A.	No PWC use.
Time Restrictions	Operations of personal watercraft from one-half hour after sunset to one-half hour before sunrise is prohibited.	Same as alternative A.	No PWC use.
Speed Restrictions	State regulations do not allow vessels, including personal watercraft, to exceed 40 mph, except during authorized race events and except for patrol vessels operating in emergencies. Above flat-wake means operating a vessel at such speed as to create a wake. Vessels cannot exceed 5 mph while in a posted flat-wake area.	Same as alternative A.	No PWC use.
Operating Restrictions	According to state law vessel and PWC operators may not operate carelessly and recklessly by becoming airborne while crossing the wake of another vessel at an unsafe distance, unsafely weaving through traffic, or operating at such a speed and proximity to another vessel that the operator of either vessel must swerve or abruptly cut speed to avoid collision.	Same as alternative A.	No PWC use.
Monitoring and Sampling			
	Current baseline and monitoring of resource including, but not limited to, water quality, shoreline erosion, Gunnison sage grouse, bird presence and abundance, and visitor use patterns would continue.	Develop and expand current baseline and monitor resource changes, including, but not limited to, water quality, shoreline erosion, Gunnison sage grouse, bird presence and abundance, and visitor use patterns.	No PWC use.
Education			
	No current program.	Establish voluntary user education program, with national recreation area providing brochures, maps, interpretive talks, etc. as part of an education program	Provide information to visitors explaining why PWC use is prohibited.

TABLE 4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No- Action Alternative: Allow No PWC Use
Water Quality	Alternative A would have negligible adverse effects on water quality based on ecotoxicological threshold volumes. All pollutant loads in 2002 and 2012 from personal watercraft and other motorboats would be well below ecotoxicological benchmarks and criteria. Water quality impacts from PWC from benzo(a)pyrene, naphthalene and benzene based on human health (ingestion of water and fish) benchmarks, and EPA and state of Colorado water quality criteria, would range from negligible to minor adverse in both 2002 and 2012. Cumulative impacts from personal watercraft and other motorboats would be negligible adverse for benzo(a)pyrene and naphthalene. Cumulative water quality impacts due to benzene would be minor to moderate adverse in 2002 and 2012 based on human health benchmarks. Impacts in Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered. Implementation of this alternative would not result in an impairment of water quality.	The impacts of alternative B would be the same as alternative A. Alternative B would have negligible adverse effects on water quality based on ecotoxicological threshold volumes. All pollutant loads in 2002 and 2012 from personal watercraft and other motorboats would be well below ecotoxicological benchmarks and criteria. Water quality impacts from PWC from benzo(a)pyrene, naphthalene and benzene based on human health (ingestion of water and fish) benchmarks and EPA and state of Colorado water quality criteria, would range from negligible to minor adverse in both 2002 and 2012. Cumulative impacts from personal watercraft and other motorboats would be negligible adverse for benzo(a)pyrene and naphthalene. Cumulative water quality impacts due to benzene would be minor to moderate adverse in 2002 and 2012 based on human health benchmarks. Impacts in Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered. Implementation of this alternative would not result in an impairment of water quality.	The no-action alternative would have a beneficial impact on water quality. Pollutant loads from personal watercraft would be eliminated. Cumulative impacts from the remaining motorboats would be negligible adverse for all ecotoxicological benchmarks and for the human health benzo(a)pyrene and naphthalene benchmarks. Impacts based on the potential effects of benzene on human health range from minor to moderate adverse in 2002 and 2012. Impacts to Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered. Implementation of this alternative would not result in an impairment of water quality.
Air Quality	Alternative A would result in negligible adverse impacts for CO, HC, PM_{10} and NO_x in 2002 and 2012. The human health risk from PAH would also be negligible. Cumulative emissions would be negligible adverse for PM_{10}, HC, and NO_x, and minor adverse for CO in 2002 and 2012. CO emissions would increase from 2002 to 2012 because of increased boating activity and cleaner engines that have higher CO emissions. This alternative would maintain existing air quality conditions, with future reductions in PM_{10} and HC emissions due to improved emission controls. Overall, PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012. Implementation of this alternative would not result in an impairment of air quality.	Alternative B would result in the same impacts as alternative A. Additional management prescriptions would not noticeably affect PWC emissions. As in alternative A, negligible adverse impacts for CO, HC, PM_{10} and NO_x would occur in 2002 and 2012. The risk from PAH would also be negligible. Cumulative emission levels would be minor adverse for CO and negligible adverse for PM_{10}, HC, and NO_x. This alternative would maintain existing air quality conditions, with future reductions in PM_{10} and HC emissions due to improved emission controls. PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012. Implementation of this alternative would not result in an impairment of air quality.	The no-action alternative would have beneficial impacts on air quality because PWC use would be banned, resulting in decreased emissions. Because PWC contribution to cumulative air quality impacts would be eliminated, cumulative impacts would be reduced, and would range from negligible adverse for PM_{10}, HC, and NO_x, to minor adverse for CO. Future emission levels would remain relatively stable, with increased CO emissions and slightly increased NO_x emissions as a result of increased boating activity and the conversion to cleaner engines. With improved emission controls, future emissions of HC and PM_{10} would continue to decline, but impacts would remain negligible to minor and adverse. Implementation of this alternative would not impair air quality.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No- Action Alternative: Allow No PWC Use
Air Quality Related Values from PWC Pollutants	Minor adverse impacts to air quality related values from PWC alone and from cumulative emissions from motorized boats and PWC could occur in both 2002 and 2012. This conclusion is based on pollutant emissions that would be less than 50 tons per year, no observed visibility impacts or ozone-related plant injury, and regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations. Implementation of this alternative would not result in an impairment of air quality related values.	The impacts of alternative B would be the same as alternative A. Minor adverse impacts to air quality related values from PWC and from cumulative emissions from motorized boats and PWC would occur in both 2002 and 2012. This conclusion is based on pollutant emissions that would be less than 50 tons per year, no observed visibility impacts or ozone-related plant injury, and regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations. Implementation of this alternative would not result in an impairment of air quality related values.	Under the no-action alternative, HC, NO_x, and $PM_{2.5}$ emissions would be less than if PWC were in use at Curecanti. There would be minor adverse impacts to air quality related values from emissions from motorized boats, without PWC, in both 2002 and 2012. This conclusion is based on regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations. Implementation of this alternative would not result in an impairment of air quality related values.
Soundscapes	Noise from PWC would have minor to moderate adverse impacts at most locations on Blue Mesa Reservoir and immediate surrounding area. Impact levels would be related to the number of personal watercraft operating as well as the sensitivity of other visitors. Cumulative noise impacts from personal watercraft, motorboats, automobiles, and other visitors would be minor to moderate adverse because these sounds would be heard occasionally throughout the day, and may predominate on busy days during the high use season. Implementation of this alternative would not result in an impairment of soundscape values.	Noise from PWC would have minor to moderate adverse impacts at most locations at Curecanti and immediate surrounding area. Impact levels would be related to the number of personal watercraft operating as well as the sensitivity of other visitors. Cumulative noise impacts from personal watercraft, motorboats, automobiles on U.S. 50, and other visitors would be minor to moderate adverse because these sounds would be heard occasionally throughout the day, and may predominate on busy days during the high use season. The lake arms and buffer zones would have speed and wake restrictions that would provide beneficial improvements to the soundscape values. Implementation of this alternative would not result in an impairment of soundscape values.	The decrease in park noise levels with the removal of PWC would have an occasionally noticeable, beneficial effect on the soundscape on high-use days because personal watercraft compromise approximately 7% of total watercraft use. Cumulative noise impacts from motorboats and other visitor activities would result in a beneficial impact to the soundscape. This alternative would not result in an impairment of soundscape values.
Wildlife and Wildlife Habitat	PWC use at Curecanti would have negligible adverse effects on fish, and negligible to minor adverse impacts on waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. Due to low levels of PWC use, coupled with a lack of substantial habitat areas, any impacts to fish, wildlife and respective habitats would be temporary and short term. The intensity and duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers would not increase substantially and engine technology would continue to improve under EPA industry regulations. On a	Impacts to wildlife in alternative B are similar to those in alternative A except the additional limitations on PWC use would slightly reduce impacts on wildlife. Expanded wake restrictions and resource monitoring would result in a beneficial impact. Cumulative adverse impacts would be the same as alternative A, and would be negligible to minor adverse due to boating activity and other visitor uses. All wildlife impacts would be temporary and short term. Implementation of this alternative would not result in impairment to wildlife or wildlife habitat.	PWC users would not be allowed to operate in Blue Mesa Reservoir, resulting in a beneficial impact on wildlife and wildlife habitat relative to alternative A, due to the elimination of interactions between PWC users and wildlife. The reduction in noise and visitor access could also have a beneficial impact on wildlife, particularly in areas of frequent PWC use, resulting in potential increased use of these areas by wildlife and waterfowl. Cumulative adverse impacts on wildlife and wildlife habitats from other shoreline visitor activities would continue to be negligible to minor adverse impacts on wildlife and wildlife habitat from

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No- Action Alternative: Allow No PWC Use
	cumulative basis, all visitor activities would have minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term. Implementation of this alternative would not result in impairment to wildlife or wildlife habitat.		wildlife and wildlife habitat from other shoreline visitor activities. PWC contribution to overall impacts to wildlife and wildlife habitat would be eliminated. No impairment of wildlife or wildlife habitat would result from this alternative.
Threatened, Endangered, or Special Concern Species	PWC use at Curecanti National Recreation Area may affect, but is not likely to adversely affect the federally or state listed bald eagle, Gunnison sage grouse, yellow-billed cuckoo, American peregrine falcon, skiff milkvetch, and Gunnison milkvetch. There would be no effect to all other federal or state listed species. All park sensitive species are unlikely to be affected. Cumulative effects from all park visitor activities would also be unlikely to cause adverse effects to special status species due to lack of species occurrences as well as a lack of access to the species or their habitats in the short or long term. Implementation of this alternative would not result in impairment of threatened or endangered species.	PWC use may affect, but is not likely to adversely affect, the same federal or state-listed species outlined in alternative A. Elimination of PWC in lake arms could beneficially affect species such as the bighorn sheep and great blue heron. Thus, buffer zones and speed restrictions could result in beneficial impacts to some species, relative to alternative A. While some cumulative disturbance could occur from PWC use, as well as other human activities on the reservoir and shoreline, these activities may affect, but are not likely to adversely affect any of the listed or park sensitive species. There would be no effect to special status species in designated areas where PWC would be prohibited or where additional speed or wake restrictions would be enforced. No impairment to any listed species would occur under this alternative.	The elimination of PWC use would result in beneficial effects, relative to alternatives A and B, to some federal or state-listed species such as the Gunnison sage grouse and to some park sensitive species. There may also be a beneficial impact to special status species of concern due to a ban on PWC use. PWC contribution to cumulative impacts to protected species would be eliminated; however, the cumulative activities of other visitors and other boaters may affect but would not likely adversely affect the listed species similar to the other alternatives. This alternative would not result in an impairment of threatened or endangered species.
Shorelines and Shoreline Vegetation	PWC use would result in a negligible adverse effect on shoreline vegetation because vegetation along the reservoir shoreline is generally lacking. Areas where vegetation may occur would be protected by wake restrictions. Cumulative impacts would be negligible to minor in the long term due to wind-related erosion, wave action, and other visitor activities such as boating. This alternative would not result in an impairment of shoreline vegetation.	PWC use would have beneficial impacts to shoreline vegetation over the short and long term relative to alternative A. The shoreline buffer and monitoring that would occur under this alternative would provide some additional protection although shoreline vegetation is limited. Adverse cumulative impacts resulting from boating activities would continue to be negligible to minor. This alternative would not result in an impairment of shoreline vegetation.	The elimination of personal watercraft would result in beneficial impacts to shoreline vegetation over the short and long term. Cumulative adverse impacts would continue to be negligible to minor, due to continued boating use and some wind-related erosion. This alternative would not result in an impairment of shoreline vegetation.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No- Action Alternative: Allow No PWC Use
Visitor Use and Experience	Reinstated PWC use would result in negligible to minor adverse impacts on experiences for most visitors in the short- and long-term under alternative A. Swimmers and other motorized boat users would be most affected by PWC use because of the popularity of the day use areas habituated by PWC, especially at Dry Creek Picnic Area, Bay of Chickens, and the windsurfing beach. PWC use would have short- and long-term negligible to minor adverse impacts for visitors who desire a more passive recreational experience and desire natural quiet. Overall, most visitors to Curecanti National Recreation Area would experience negligible to minor adverse effects under this alternative and would be satisfied with their experiences at Curecanti National Recreation Area. Cumulative effects of PWC use, other watercraft, and other visitors would result in short and long-term, negligible to minor adverse impacts.	PWC management strategies such as shoreline zoning would have negligible to minor adverse impact on most PWC users, because most of the more popular PWC use locations at the park would remain available for use. Some PWC users would experience short term minor to moderate adverse impacts due to speed restriction in the lake arms, but overall PWC users would experience a long term negligible to minor adverse impact due to buffers and wake restrictions. Shoreline users, those seeking more natural surroundings, and non-motorized and motorized boaters using the lake arms would experience beneficial impacts and visitors using the main body would experience negligible to minor adverse impacts. Cumulative effects of PWC use, other watercraft, and other visitors would result in short and long-term, negligible to minor adverse impacts.	The no-action alternative would have a beneficial impact on the experiences of most non-PWC using visitors due to the ban of PWC. Impacts on PWC users, particularly local residents, who would no longer be able to ride in the national recreation area would be short and long term, moderate to major, and adverse.
Visitor Conflicts and Safety	Reinstated PWC use would have short-term negligible to minor adverse and long-term, minor adverse impacts on visitor conflicts and safety, particularly in the noted high PWC use locations due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts at other locations would remain negligible adverse because use is lower and conflicts would be less likely to occur. Cumulative impacts related to visitor conflicts and safety would be minor adverse for all user groups in the short and long term, particularly near the high-use areas. Cumulative impacts in other areas of the reservoir would be negligible adverse.	Reinstated PWC use with the management prescriptions of alternative B would have short- and long-term, minor to moderate adverse impacts on visitor conflicts and safety in the high use areas and boat launches due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts at lake-arm locations would be negligible to minor adverse because PWC speed would be zoned and conflicts would be less likely to occur. Cumulative impacts related to visitor conflicts and safety would be minor to moderate adverse for all user groups in the short and long term, particularly near the high-use areas. Cumulative impacts in lake arms would be negligible adverse because of reduced use.	Discontinuing PWC use would result in short- and long-term, beneficial impacts by reducing visitor conflicts and enhancing safety. PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be beneficial.

Impact Topic	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No- Action Alternative: Allow No PWC Use
Cultural Resources	PWC use within the national recreational area could have minor adverse impacts on listed or potentially listed archeological sites from possible illegal collection and vandalism. Cumulative impacts on archeological resources that are readily accessible could be minor to major adverse, due to the number of visitors and the potential for illegal collection or destruction. Implementation of this alternative would not result in an impairment of cultural resources.	Modification of flat-wake speed zones and speed restrictions from arm areas into main body areas could have minor adverse impacts on listed or potentially listed archeological resources from possible illegal collection and vandalism. There would also be a beneficial impact on those resources from the reduced erosion resulting from lower speeds. Cumulative impacts of other activities on archeological resources that are readily accessible could be minor to major and adverse, due to the number of visitors and the potential for illegal collection or destruction. Implementation of this alternative would not result in an impairment of cultural resources.	Prohibiting PWC use would have beneficial impacts on archeological sites. Cumulative impacts from all other visitor activities would be minor to major, depending on the accessibility of the resource and the potential for illegal collection or damage by non-PWC users. Implementation of this alternative would not result in an impairment of cultural resources.
Socioeconomic Effects	No change in consumer surplus for PWC users or other visitors. No change in producer surplus to producers of PWC or non-PWC services. No change in welfare to local residents or the general public.	Very slight decrease in consumer surplus for PWC users. Slight increase in consumer surplus of non-PWC visitors. No change in producer surplus of producers of PWC services and small increase in producer surplus for producers of non-PWC services. Slight decrease in welfare to local residents who use PWC. Slight increase in welfare of local residents who do not use PWC as well as to the general public.	Decrease in consumer surplus for current and future PWC users. Increases in consumer surplus for most non-PWC visitors. Decrease in producer surplus for PWC rental and retail shops. Decrease in producer surplus for hospitality services in the area. Increase in producer surplus for producers of services to non-PWC park visitors. Increase in welfare to the general public and local residents who do not use PWC. Decrease in welfare to local residents who use PWC.
National Recreation Area Management and Operations	**Conflict with State and Local PWC Ordinances and Policies**		
	PWC regulations within the national recreation area would include NPS and state regulations. Reinstated PWC use under alternative A would not result in conflicts with state regulations. Therefore, impacts (including cumulative impacts) would be negligible adverse.	PWC use restrictions under alternative B would not result in conflicts with state PWC regulations or policies. Management prescriptions would apply only within the recreation area's jurisdictional boundary. Impacts related to conflicts with federal or state requirements or policies would be negligible adverse.	Discontinuing PWC use within the national recreation area would not result in conflict with state PWC regulations or policies. There are no local PWC regulations. Therefore, impacts related to such conflicts (including cumulative impacts) would be negligible adverse.
	Park Operations and Increased Enforcement Needs		
	This alternative would have moderate adverse impacts on park operations. More staff, funding, equipment, and educational material would be needed to regulate existing PWC as well as boating use. Implementation of this alternative would not result in impairment to park operations.	Similar to alternative A, this alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be needed to ensure full compliance with PWC management prescriptions for additional monitoring included as a part of this alternative. Implementation of this alternative would not result in impairment to park operations.	This alternative would have negligible adverse impacts on park operations. No additional staff, funding, or equipment would be needed to ensure compliance with the PWC ban and to regulate existing boating use, although staff may initially need to spend more time and effort educating visitors until they became fully aware of the PWC ban. Implementation of this alternative would not result in impairment to park operations.

TABLE 5: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Water Quality				
The vast majority of personal watercraft in use today are carbureted, two-stroke engines, which discharge as much as 30% of their fuel directly into the water (NPS 1999; CARB 1999). Hydrocarbons, including benzene, toluene, ethyl benzene, and xylene; and PAH are released, as well as MTBEs. These discharges have potential adverse effects on water quality.	Manage PWC emissions that enter the water in accordance with NPS anti-degradation policies and goals.	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.
Some research shows that PAH, including those from personal watercraft emissions, adversely affect water quality via harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). Curecanti is located at a high altitude, has clear water and receives an abundance of solar input. These environmental factors, in combination with PAH, can affect aquatic life and, ultimately, aquatic food chains. The primary concern is in shallow water ecosystems.	Protect plankton and other aquatic organisms from PWC emissions so that the viability of dependent species is conserved.	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.
Curecanti is part of the Wayne N. Aspinall Storage Unit and is one of four units that comprise the Upper Colorado River Storage Project. The Aspinall Storage Unit provides water for many purposes to downstream users including power generation and water storage. Municipalities downstream from Curecanti may divert water from the Gunnison Tunnel for local exchange.	Manage PWC emissions so that Curecanti National Recreation Area continues to meet state of Colorado drinking water standards	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.
Water from Curecanti flows into the Gunnison River where the Colorado River cutthroat trout, a vulnerable state species of concern occurs.	Manage PWC emissions so that the quality of water flowing into the river does not adversely affect the Colorado River cutthroat trout and other fish.	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
PWC emissions may have an effect on fish recruitment and survival.	Manage PWC emissions so that water does not adversely affect fish recruitment and survival.	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.
Air Quality				
Pollutant emissions, particularly NO_x and HC from personal watercraft, may adversely affect air quality. These compounds react with sunlight to form ozone. To the extent that nitrogen loading in the air contributes to the nutrient loading in the water column, PWC use adversely affects water quality.	Manage PWC activity so that PWC air emissions of harmful compounds do not appreciably degrade ambient air quality.	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Meets objective through EPA-regulated conversion to cleaner engines (EPA 1996a, 1997).	Fully meets objective.
Soundscapes				
Noise limits established by the NPS require vessels to operate at less than 82 dB at 82 feet.	Manage noise from PWC use in affected areas so that visitors' health, safety, and experiences are not adversely affected.	Meets objective. New machines may also generate less noise (EPA 1996a, 1997).	Meets objective. New machines may also generate less noise (EPA 1996a, 1997).	Fully meets objective (EPA 1996a, 1997).
Wildlife and Wildlife Habitat				
Some research suggests that PWC use impacts wildlife through interruption of normal activities, alarm or flight; avoidance and displacement of habitat; and effects on reproductive success. This is thought to be caused by a combination of PWC speed, noise and ability to access sensitive areas, especially in shallow-water depths. Literature suggests that personal watercraft can access sensitive shorelines, disrupting riparian habitat areas critical to wildlife.	Protect birds, waterfowl, and other wildlife from the effects of PWC noise.	Meets objective with areas of use and flat wake.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts.	Fully meets objective.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Deer, elk and bighorn sheep occur mostly in terrestrial habitat adjacent to the lake arms. There is potential for the noise to reverberate if personal watercraft are running fast, but the lake arms have flat-wake speed restrictions to prevent these noise impacts (see *General Management Plan* [NPS 1997] for additional information). The potential exists for noise impacts on smaller wildlife such as squirrels, skunks, and porcupines that are in areas close to the reservoir.	Protect fish and wildlife including the bald eagle, great blue heron [park native species of special concern], Gunnison sage grouse [park native species of special concern and federal candidate], and their habitats from PWC disturbances.	Meets objective with areas of use and flat wake.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts.	Fully meets objective.
Animals also could be affected when PWC users are operating illegally in areas where flat-wake speed restrictions do apply.	Protect fish and wildlife from the adverse effects that result from the bio-accumulation of contaminants emitted from personal watercraft.	Meets objective because threatened and endangered species primarily occur during off-season for PWC use and potential impact is minimal.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts, and because potential impact is minimal.	Fully meets objective.
Threatened, Endangered, and Special Concern Species				
A variety of state and federally listed and park sensitive species are found at Curecanti. The Colorado River cutthroat trout is found in the Gunnison River, downstream of Crystal Reservoir and the Crystal Dam. The species does not occur in Sapinero, Cebolla or Iola Basins, which comprise Blue Mesa Reservoir. Water from Curecanti flows into the Gunnison River and could potentially affect the habitat of this species. However, PWC use occurs only on Blue Mesa Reservoir. Morrow Point and Crystal Reservoirs are located between Blue Mesa and the Gunnison River, providing substantial dilution for PWC pollutant emissions prior to reaching the river.	Protect threatened and endangered species, and species of special concern, and their habitats from PWC disturbances.	Meets objective because threatened and endangered species primarily occur during off-season for PWC use and potential impact is minimal.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts, and because potential impact is minimal.	Fully meets objective.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
In some areas personal watercraft could cause harm to the great blue heron (park native species of special concern) and Colorado River cutthroat trout, (vulnerable state species of concern), the Gunnison sage grouse (federal candidate species), and two astragalus species, (state imperiled plants), because of the machine's operational characteristics and users' ability to access areas of species habitat.	Protect threatened and endangered species, and species of special concern, and their habitats from PWC disturbances.	Meets objective because threatened and endangered species primarily occur during off-season for PWC use and potential impact is minimal.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts, and because potential impact is minimal.	Fully meets objective.
The Gunnison sage grouse, a federal candidate species, is not a waterfowl but nests close to water at the Stevens Creek Campground. A historical lek (mating) site for the Gunnison sage grouse occurs on the south side of the highway at the Stevens Creek Campground. Lek habitat for the Gunnison sage grouse consists of open areas within sagebrush vegetation with good visibility (for predator detection) and acoustics (for transmission of male display sounds) (USFWS 2000). The great blue heron, a park native species of special concern, could be affected if visitors were engaging in illegal PWC use. Bald eagles are in the park but do not nest around the reservoir during the months when personal watercraft are in use.	Protect threatened and endangered species, and species of special concern, and their habitats from PWC disturbances.	Meets objective because threatened and endangered species primarily occur during off-season for PWC use and potential impact is minimal.	Meets objective by creating flat-wake buffer zones as well as expanded monitoring of resource impacts, and because potential impact is minimal.	Fully meets objective.
Two astragalus species, listed by the state as imperiled and critically imperiled, occur in dry upland areas that could be accessed on the south shore around Middle Bridge. These plants are also accessible by other means.	Manage PWC use to protect astragalus species.	Meets objective because there are no astragalus species believed to be at risk from personal watercraft.	Meets objective.	Fully meets objective.
Shoreline Vegetation				
Personal watercraft are able to access areas such as shallow waters where most other watercraft cannot go, which may result in disturbance of sensitive plant species. In addition, personal watercraft may land on the shoreline allowing visitors to access areas where sensitive vegetation and plants species exist. However, these species are also easily accessible by vehicles and other vessels.	Manage PWC use to protect sensitive shoreline areas from PWC activity and access.	Meets objective because potential for risk is low.	Fully meets objective because of expanded monitoring and potential for risk is low.	Fully meets objective.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
When the reservoir is at full pool, which does not occur often, wake from personal watercraft and other watercraft could affect shoreline vegetation. However, gusty winds are more likely to cause more erosion than PWC use. There are no sensitive shoreline plant species although there are dry upland species that visitors could access once they disembark from their personal watercraft.	Manage PWC use to protect sensitive shoreline areas (vegetation/ erosion) from PWC activity and access.	Meets objective because potential for risk is low.	Meets objective with expanded monitoring of resource impacts.	Fully meets objective.
Visitor Use and Experience				
Some research suggests that personal watercraft are viewed by some segments of the public as a 'nuisance' due to their noise, speed and overall environmental effects, while others believe personal watercraft are no different than other watercraft and that users have a "right" to enjoy the sport.	Minimize potential conflicts between PWC use and park visitors.	Meets objective due to low reported visitor conflict and continued use of personal watercraft.	Meets objective due to low reported visitor conflict and continued use of personal watercraft.	Does not meet objective. Would lower the satisfaction of PWC owners.
Some states and local governments have taken action, or are considering taking action, to limit, ban and otherwise manage PWC use. While the park may be 'exempt' from these local actions, consistency with state and local plans must be considered. The state of Colorado has PWC regulations that provide guidelines for PWC operation and safety at Curecanti.	Seek cooperation with state entities that regulate PWC use.	Meets objective. No conflicts between state and local regulations.	Meets objective. No conflicts between state and local regulations.	Meets objective. No conflicts between state and local regulations.
The *General Management Plan* (NPS 1997) discusses Curecanti National Recreation Area's mandate "for public use and enjoyment." PWC management may affect the enhancement of recreational opportunities or cause changes in the methods and types of recreational activities occurring within the park (NPS 1997).	Manage PWC use consistent with authorizing memorandum of agreement, and provide a wide range of recreational activities consistent with conservation of natural and cultural values.	Meets objective by allowing PWC use.	Meets objective by allowing PWC use.	Does not meet objective. Ban on personal watercraft would limit range of recreational consistent with authorizing memorandum of agreement.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Visitor Conflict and Visitor Safety				
The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of the registered "vessels" in the United States but were involved in 36% of all boating accidents. In part, this is believed to be a "boater education" issue (for example, inexperienced riders lose control of the craft) and also a function of the PWC operation, that is, no brakes or clutch. When drivers let up on the throttle to avoid a collision, manual steering becomes difficult (NTSB 1998).	Minimize or reduce the potential for PWC user accidents.	Meets objective. There has only been one accident involving PWC between 1995 and 2002.	Meets objective by establishing a voluntary user education program. There has only been one accident involving PWC between 1995 and 2002.	Fully meets objective.
Due to their ability to reach speeds in the 60 mph range and their ability to access shallow-draft areas, personal watercraft can create wakes that pose a conflict for both shore and boat fishermen and a safety hazard to other users such as canoeists, kayakers and windsurfers. The biggest PWC infraction at Curecanti is ignoring flat-wake speed zones. Conflicts occur in cliff diving areas west of Dry Creek and near U.S. 50 near Bay of Chickens. The superintendent has received a few complaints about PWC/fishermen conflicts. While no PWC accidents have been reported in the last five years, the share of PWC citations is disproportionately large. During the five-year period PWC account for less than 6% of the total watercraft but over 20% of all watercraft citations.	Minimize or reduce the potential for safety conflicts between PWC users and other water recreationists.	Meets objective. There has only been 1 accident involving PWC between 1995 and 2002.	Meets objective by establishing a voluntary user education program and implementation of flat-wake zones along the south shore. There has only been one accident involving PWC between 1995 and 2002.	Fully meets objective.
Managing personal watercraft under a more restrictive strategy may require additional park staff to enforce standards and limits.	Minimize or reduce the potential for user conflicts between PWC users and shore and boat fishermen.	Meets objective due to state regulations.	Meets objective due to state regulations and with increased and enhanced enforcement of new restrictions.	Fully meets objective.

Issue	Objective	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
Cultural Resources (Section 106)				
Curecanti National Recreation Area has archeological and paleonotological resources listed on or eligible for listing on the National Register of Historic Places (NRHP) that may be affected by PWC use. Uncontrolled visitor access by personal watercraft, as well as other vessels and vehicles, may affect the resources since riders and drivers are able to access, beach, or launch in the areas that might otherwise be inaccessible. Personal watercraft operating at high rates of speed could create a wave action that results in shoreline erosion, thus exposing resources to increased damage.	Manage PWC use and access to protect cultural and paleontological resources.	Meets objective with establishment of flat-wake zones and restrictions.	Meets objective with establishment of flat-wake zones and restrictions.	Fully meets objective.
Socioeconomic Environment				
National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001 (refer to table 1). Statewide PWC registrations have also decreased between 2001 and 2002.	Work cooperatively with concessioners and local businesses that rent or sell personal watercraft.	Meets objective. No local businesses impacted.	Meets objective. No local businesses impacted.	Does not meet objective because lack of PWC sales or rentals would result in slightly reduced expenditures by PWC users.
Personal watercraft can be rented or bought in Grand Junction. One company in Montrose sells personal watercraft, which accounted for 1% of their business in 2001 and 2002. The company does not rent personal watercraft. Most visitors arrive at Curecanti with personally owned vessels.	Work in cooperation with local businesses.	Meets objective. No local businesses impacted.	Meets objective. No local businesses impacted.	Does not meet objective because of the relatively small percentage.
National Recreation Area Management and Operations				
PWC use may require additional park staff to enforce standards, limits, or closures because of increased accident rates and visitor conflicts.	Provide a safe and healthful park environment for park visitors.	Meets objective. Increase in use may result in increased patrol needs.	Meets objective. Increase in use may result in increased patrol needs.	Fully meets objective.
Some states and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While the park may be exempt from these local actions, consistency with state and local plans must be evaluated.	Seek cooperation with state entities that regulate PWC use.	Meets objective with federal, state, and local cooperation.	Meets objective with federal, state, and local cooperation.	Fully meets objective.

AFFECTED ENVIRONMENT

WATER QUALITY

PHYSICAL CHARACTERISTICS OF BLUE MESA RESERVOIR

Blue Mesa Reservoir, formed by the Blue Mesa Dam on the Gunnison River, is the largest body of water in Curecanti National Recreation Area as well as the state of Colorado. Downstream and to the west of Blue Mesa Reservoir is Morrow Point Reservoir where the Black Canyon of the Gunnison begins. Further downstream, Crystal Reservoir is located above the site of the Gunnison Diversion Tunnel. Together, this complex of dams and three reservoirs is called the Wayne N. Aspinall Storage Unit and is one of four units belonging to the Upper Colorado River Storage Project managed by the Bureau of Reclamation. The Aspinall Storage Unit produces electricity and provides and regulates water storage to the Upper Colorado River Basin states of Colorado, Wyoming, New Mexico, and Utah (NPS 2002b).

Rising 390 feet, the high earth and rock fill Blue Mesa Dam was completed in 1965, impounding the Gunnison River to create the largest body of water in Colorado extending over 20 miles with 96 miles of shoreline (NPS 2002b). Blue Mesa Reservoir is comprised of three basins: Sapinero, Cebolla, and Iola. Just behind the dam, Sapinero Basin is the deepest of the three basins with depths greater than 300 feet. Sapinero is not as productive as the more upstream basins. East of Sapinero is Cebolla Basin, which is more productive, with depths approximating 200 feet. The easternmost basin, Iola, is the shallowest, with depths around 100 feet. More riverine in character, Iola Basin is warmer than Sapinero or Cebolla Basins, and is a relatively narrow zone at the upstream side of a reservoir where water is well mixed and fine suspended sediment are transported. The entire reservoir is considered mesotropic (Bauch and Malick, 2003).

The water within Blue Mesa Reservoir undergoes two periods of mixing each year (dimictic), once in the spring and, again, in the fall. After the water mixes in the spring, warmer air temperatures heat the waters above the thermocline (the depth at which temperature drops in the temperature profile of the lake). The depth of the thermocline varies during the course of each year. Temperature profile data from 1995 through 2002 was used to determine the depth of the thermocline at Blue Mesa Reservoir. Data was available during periods of peak visitor use (Fourth of July) in Iola, Cebolla and Sapinero basins for this seven-year period of record. The average depth to the thermocline for each of these basins ranged from 6.3 to 6.85 meters. Thus, an average depth to the thermocline for Blue Mesa Reservoir is estimated to be 6.5 meters, or approximately 21 feet, during the peak visitor use season (NPS 2002f).

The maximum pool elevation at Blue Mesa Reservoir is 7,519 feet above mean sea level, with a corresponding volume of 940,700 acre-feet and a surface area of 9,158 acres. In comparison, the minimum pool elevation is 7,393 feet above mean sea level with a corresponding volume of 192,270 acre-feet and a surface area of 2,790 acres. The lowest lake level recorded at Blue Mesa Reservoir was 7,428 feet, which occurred on April 16, 1984. The reservoir had been lowered to that level in anticipation of high runoff. Historically, the water elevation at the reservoir has never fallen to the minimum pool elevation. The current lake level at Blue Mesa (January 14, 2003) is 7,445 feet above mean sea level, which is 52 feet above the minimum pool elevation. Because of drought conditions currently being experienced in Colorado, the Bureau of Reclamation has reduced reservoir releases from Crystal Reservoir to 250 cfs. Inflows from stream flow to the reservoir should meet or exceed these releases, allowing the reservoir to begin filling again (McCall 2002).

A mixing zone occurs above the thermocline and extends to the reservoir surface. If a minimum pool elevation is assumed (7,393 feet), then the top of the thermocline would be located at an elevation of 7,372 feet. The volume of water at an elevation of 7,372 is 139,837 acre-feet. Therefore, by subtracting

the volume at the thermocline (139,837 acre-feet) from the minimum pool volume (192,270 acre-feet), the remaining volume of 52,433 acre-feet is the effective mixing zone.

COLORADO WATER QUALITY STANDARDS

Classification of Waters. Water quality standards for the Gunnison River Basin have been established as part of Regulation Number 35 drafted by the Colorado Department of Public Health and Environment (CDPHE) – Water Quality Control Commission (CDPHE 2002c). Under these regulations, water bodies are designated for specific uses. Blue Mesa, Morrow Point and Crystal Reservoirs are designated to be suitable for class 1, Cold Water Aquatic Life; class 1a, Recreation (Primary Contact); Water Supply; and Agriculture.

- Waters designated as class 1, Cold Water Aquatic Life, are defined as waters capable of sustaining a wide variety of cold-water biota, including sensitive species. Waters with this designation are considered capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.

- Waters designated as class 1a, Recreation (Existing Primary Contact), are defined as waters that are suitable for recreational activities in or on the water when the ingestion of small quantities of water is likely to occur.

- The Water Supply designation applies to surface waters that are suitable for potable water supplies. After receiving standard treatment these waters would meet Colorado drinking water regulations.

- The agriculture designation applies to surface waters suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock can be classified for Agricultural use.

Antidegradation Standards. Section 31.8 of *The Basic Standards and Methodologies for Surface Waters* (CDPHE 2001b) provides regulations for the quality of water in the state of Colorado. These regulations provide three levels of protection. Designations based on aquatic life and use are provided to determine the level of protection applicable to specific water bodies. Blue Mesa Reservoir is designated as "reviewable" and requires that its water quality be protected at its existing quality unless it is determined that allowing poorer water quality is necessary to accommodate important economic or social development in the area in which the waters are located (CDPHE 2001a). National Park Service policy, however, promotes anitdegradation of water quality from any permitted use within a park unit.

Numeric Standards. The Colorado Department of Public Health and Environment (CDPHE) lists organic standards applicable to waters in Colorado according to the classification defined for the specific water body as described above (Water Quality Control Commission, Regulation No. 31 [CDPHE 2001b], Basic Standards and Methodologies for Surface Water, Section 31.11). Organic water quality standards applicable to Blue Mesa Reservoir (applied to all aquatic life class 1 water bodies that also have a water supply classification) are labeled "Water + Fish." Colorado standards are provided for typical gasoline organic constituents such as benzo(a)pyrene, naphthalene, 1-methyl naphthalene, and benzene. However, the state does not provide a standard for 1-methyl naphthalene. Table 6 lists these standards.

TABLE 6: STATE OF COLORADO WATER QUALITY STANDARDS FOR ORGANIC CHEMICALS

Classification[a]	Benzo(a)pyrene (µg/L)	Naphthalene (µg/L)	Benzene (µg/L)
Water + Fish[b]	0.0044	28	1.2

Source: CDPHE 2001b.

a. Colorado Standard applied to aquatic life class 1 waters with water supply classification.

b. Human Health based standards.

The Colorado standard for benzo(a)pyrene is less restrictive than the EPA human health criteria of 0.0038 µg/L (EPA 2002c). The Colorado standard for benzene is more restrictive than the EPA human health criteria of 2.2 µg/L (EPA 2002c). The Colorado human health based standard for naphthalene of 28 µg/L is more restrictive than the ecotoxicological benchmark standard of 62 µg/L (CDPHE 2001a).

WATER QUALITY DATA

Monitoring for organic chemicals was initiated at Blue Mesa Reservoir in May 2000. Samples were collected at two sites on May 24, 2000, and July 5 and 6, 2000. Results from these analyses are, at best, a "snapshot" of the levels of organic constituents in the reservoir. Further, the analyses are not considered reproducible due to significant variation in duplicate sample results and concentration spikes found in blank samples. With those qualifications, it can be said that concentrations of BTEX, MTBE and PAH in water found in the collected samples did not exceed published aquatic life and human health criteria (NPS 2002f).

MOTORIZED WATERCRAFT AND WATER QUALITY

Motorized boating activity within Blue Mesa Reservoir includes fishing boats, inboard/outboard ski boats, and personal watercraft. Emissions from these watercraft contribute pollutants of concern to the waters of the reservoir. The quantity of pollutants contributed depends on the type and number of watercraft and the length of time they operate within the reservoir.

The primary pollutants of concern that may be emitted from marine engines include MTBE, PAH, and BTEX. MTBE has been successful in reducing air pollution, however, it has been controversial from a water quality perspective. Colorado is the only state that currently has a full ban on the use of MTBE in gasoline (U.S. Department of Energy [DOE] 2002).

AIR QUALITY

Curecanti is in a sparsely populated area on the western slope of the Rocky Mountains and is within the Western Slope Region for air quality planning (CDPHE 2002b). The park is classified as a class II air quality area.

Low population levels and lack of large industries have meant high standards of air quality and good visibility on a year-round basis. High winds occasionally generate dust storms in the park when the reservoir is low (NPS 1997).

The Air Quality Control Commission of the Colorado Department of Public Health and Environment (CDPHE) is responsible for monitoring and evaluating air quality in the state. The CDPHE has adopted

the federal national ambient air quality standards (NAAQS) except where noted in table 7 under the Colorado standards. Current standards are set for sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, particulate matter equal to or less than 10 microns in size (PM_{10}), fine particulate matter equal to or less than 2.5 microns in size ($PM_{2.5}$), and lead (Pb). These pollutants are collectively referred to as criteria pollutants.

TABLE 7: NATIONAL AND COLORADO AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	NAAQS[a]		Colorado[b]
		Primary[c]	Secondary[d]	Concentration[e]
Ozone (O_3)[f]	1-Hour	0.12 ppm (235 µg/m^3)	Same as Primary Standard	0.12 ppm (235 µg/m^3)
	8-Hour	0.08 ppm (157 µg/m^3)		—
Carbon Monoxide (CO)	8-Hour	9.0 ppm (10 mg/m^3)	—	9.0 ppm (10 mg/m^3)
	1-Hour	35 ppm (40 mg/m^3)		35 ppm (40 mg/m^3)
Nitrogen Dioxide (NO_2)	Annual Average	0.053 ppm (100 µg/m^3)	Same as Primary Standard	0.053 ppm (100 µg/m^3)
Sulfur Dioxide (SO_2)	Annual Average	0.03 ppm (80 µg/m^3)	—	See note g
	24-Hour	0.14 ppm (365 µg/m^3)	—	
	3-Hour	—	1300 µg/m^3 (0.5 ppm)	
Suspended Particulate Matter (PM_{10})	24-Hour	150 µg/m^3	Same as Primary Standard	150 µg/m^3
	Annual Arithmetic Mean	50 µg/m^3		50 µg/m^3
Fine Particulate Matter ($PM_{2.5}$)[f]	24-Hour	65 µg/m^3	Same as Primary Standard	—
	Annual Arithmetic Mean	15 µg/m^3		
Lead (Pb)	Calendar Quarter	1.5 µg/m^3	Same as Primary Standard	—
Visibility	No Federal Standard			See note h

mg/m^3 = milligrams per cubic meter; µg/m^3 = micrograms per cubic meter; ppm = parts per million; dash (-) indicates no standard

Source: (EPA 2003a, CDPHE 2002a).

a. National Ambient Air Quality Standards (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year.

b. Colorado Ambient Air Quality Standards (other than annual averages) are not to be exceeded more than once per year.

c. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

d. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

e. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 millimeters (mm) of mercury. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar). Ppm in this table refers to ppm by volume or micromoles of pollutant per mole of gas.

f. New federal 8-hour ozone and fine particulate matter standards were promulgated by EPA on July 18, 1997. The federal 1-hour O_3 standard continues to apply in areas that violated the standard. Contact EPA for further clarification and current federal policies. (The federal standards for 8-hour ozone and $PM_{2.5}$ became effective on September 15, 1997, and were subsequently challenged and litigated. The U.S. Supreme Court affirmed the standards, and policies and systems to implement these new standards are being developed. No attainment classifications have been made for these pollutants. No new controls with respect to the new standards have been promulgated.)

g. The Colorado SO_2 standard contains more detail than can be easily displayed in this table. SO_2 is not a pollutant of interest for this environmental assessment, and therefore, the detail is not included.

h. The Colorado visibility standard contains more detail than can be easily displayed in this table. The standard is applicable in the Denver area, and not in the project area, and therefore, the detail is not included.

Areas are classified under the federal *Clean Air Act* as either "attainment" or "nonattainment" areas for each criteria pollutant based on whether the NAAQS have been achieved or not. When an area has been designated as an attainment area after having been nonattainment, it is also classified as a maintenance area. Colorado has experienced a decline in air pollutants over the past 15 to 20 years. In 1995, Colorado had 12 areas of nonattainment; today there are no areas of nonattainment. However, areas of concern in Colorado are ozone levels in the Denver metropolitan area and PM_{10} and $PM_{2.5}$ levels in mountain communities (CDPHE 2002b).

The nearest air quality monitoring station is in Gunnison, 8 miles east of Curecanti. The CDPHE operates PM_{10} monitoring sites in Gunnison, Delta, Crested Butte and Mt. Crested Butte. In the past few years, there have also been PM_{10} monitoring sites in Montrose, Olathe, Paonia and Hotchkiss. Carbon monoxide, PM_{10}, and $PM_{2.5}$ are also monitored at a site in Grand Junction. EPA operates an ozone monitor at Gothic, near Crested Butte.

The Report to the Public prepared by the Air Pollution Control Division of the CDPHE and published by the Colorado Air Quality Commission in October 2002 reported that the only exceedance of standards in 2001–2002 in the Western Slope region was in Steamboat Springs, with a PM_{10} value that was 110% of the 24-hour standard. Data from the National Air Quality and Emissions Trends Report (EPA 1999) indicate that PM_{10} levels in Gunnison County are in the normal range for the state (CDPHE 2002a).

The National Park Service maintains records of ozone levels measured as SUM06, which provide an indication of overall regional ozone exposure. The SUM06 data are based on the 3-month highest measured values averaged over a five-year period and obtained during daylight hours. Current values indicate regional ozone levels in the area of Curecanti are between 12 and 19 parts per million (ppm)-hours (EPA 1999).

Visibility, as indicated by $PM_{2.5}$ in the area of Curecanti is generally good (EPA 2002e).

SOUNDSCAPES

Soundscapes include both natural and human components. Natural soundscapes include all naturally occurring sounds such as waves on the shoreline, running water, bird calls, wind blowing through trees or the sound of thunder. It also includes "natural quiet" that occurs in the absence of natural or human caused sound. The opportunity to experience natural sounds is an enjoyable part of some visitors experience at the recreation area.

Common human-caused sounds at Curecanti include engines from PWC and other vessels, vehicle noise, human vocalizations, radios and other sounds generated by people picnicking and camping. Human sounds are not unexpected or inappropriate at the recreation area, but are a part of the overall soundscape in an area where water activities, picnicking, camping and other recreation use are part of the purpose of the park. Evaluation of the appropriateness of human sounds is accomplished by considering visitor expectation, management guidelines, resource sensitivity and park purpose.

NATURAL AND HUMAN NOISE LEVELS

Noise is generally defined as an unwanted or intrusive sound. Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). Since the human ear is more sensitive to middle and high frequency sounds than to low frequency sounds, sound levels are weighted to reflect human perceptions more closely. These

"A-weighted" sounds are identified by the symbol dBA. Table 8 illustrates common sounds and the measured sound level.

For the average human, a 10-dBA increase in the measured sound level is subjectively perceived as being twice as loud, and a 10-dBA decrease is perceived as half as loud. The decibel change at which the average human would indicate that the sound is just perceptibly louder or perceptibly quieter is 3 dB. There is generally a 6-dBA reduction in sound level for each doubling of distance from a noise source due to spherical spreading loss (e.g., if the sound level at 25 feet from a PWC was 86 dBA, the sound level at 50 feet would be expected to be 80 dBA, at 100 feet 74 dBA, and so forth).

Many factors affect how an individual responds to noise. Primary acoustical factors include the sound level, the distribution of sound levels across the frequency spectrum, and the duration (and other time-related factors such as how often it occurs, and timing sensitivity) of the sound. Secondary acoustical factors include the spectral complexity, sound level fluctuations, frequency fluctuation, rise-time of the noise, and localization of the noise source (Mestre Greve Associates 1992).

Non-acoustical factors also play a role in how an individual responds to sounds. Non-acoustical factors vary from the past experience and adaptability of an individual to the predictability of when a noise will occur. The listener's activity will also affect how he/she responds to noise.

Personal watercraft and outboard motors are similar in the noise they generate. The National Park service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris et al. 2002). The results show that maximum personal watercraft noise levels at 25 meters (82 feet) ranged between 68 to 76 decibels on the A-weighted scale (dBA). Noise levels for other motorboat types measured during that study ranged from 65 to 86 decibels at 25 meters (82 feet). However, unlike motorboats, personal watercraft are highly maneuverable, often resulting in quickly varying noise levels due to changes in acceleration and exposure of the jet exhaust when crossing waves. The frequent change in pitch and noise levels, especially if operated closer to land, make the noise from personal watercraft more noticeable to human ears (Asplund 2001).

TABLE 8: SOUND LEVEL COMPARISON CHART

Decibels	How it Feels	Equivalent Sounds
140–160	Near permanent damage level from short exposure	Large caliber rifles (e.g., .243, 30-06)
130–140	Pain to ears	.22 caliber weapon
100	Very loud Conversation stops	Air compressor at 20 feet; garbage trucks and city buses; power lawnmower; diesel truck at 25 feet
90	Intolerable for phone use	Steady flow of freeway traffic; 10 hp outboard motor; garbage disposal
80		Muffled jet ski at 50 feet; automatic dishwasher; near drilling rig; vacuum cleaner
70		Drilling rig at 200 feet; window air conditioner outside at 2 feet
60	Quiet	Window air conditioner in room; normal conversation
50	Sleep interference	Quiet home in evening; drilling at 800 feet; bird calls
40		Library
30		Soft whisper
20		In a quiet house at midnight; leaves rustling

Note: Modified from Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida (U.S. Department of the Interior, n. d.).

VISITOR RESPONSES TO PWC NOISE

Many factors affect how an individual responds to noise. Primary acoustical factors include the sound level, its frequency, and duration. Secondary acoustical factors include the spectral complexity, sound level fluctuations, frequency fluctuation, rise-time of the noise, and localization of the noise source (Mestre Greve Associates 1992). Each of these factors is sensed relative to the ambient soundscape that exists without the specific noise under consideration. Non-acoustical factors also play a role in how an individual responds to sounds. These factors vary from the past experience and adaptability of an individual to the predictability of when a noise will occur.

As noted above, the ambient, or background soundscape will affect a listener's perception of sound or noise. A single vehicle engine near a busy highway is not noticed, while the same engine in a quiet, isolated location may be very intrusive. The listener's activity also affects how he/she responds to noise. For example, for users of PWC who are picnicking near the water edge and can hear the sounds of PWC, the sound may not be bothersome, but non-PWC users in the same location may be annoyed by the sound.

Specific areas within the park where visitors may be sensitive to noise include the surface of Blue Mesa Reservoir and surrounding campgrounds, picnic areas, and hiking trails, Including Stevens Creek, Elk Creek, Dry Gulch, and Lake Fork campgrounds as well as Blue Mesa, Old Stevens, Iola, Dry Creek, Bay of Chickens, Dillon Pinnacles, McIntyre Gulch, and Elk Creek picnic areas. Visitors would likely be less sensitive to noise in those areas located close to U.S. 50, which runs along Blue Mesa Reservoir, often close to the shoreline, and rarely more than 0.75-mile away from the shoreline; therefore providing a relatively high ambient automobile noise.

Noise sensitive activities that may occur throughout the reservoir and immediate area include boat and shoreline fishing, and wildlife watching. Noise related to PWC and other watercraft, and sounds related to other human activity, are typically highest during the summer months, especially at Elk Creek and Lake Fork, where most PWC launch. PWC generate noise that varies in pitch and frequency due to the nature of their construction and use. The two-stroke engines are often used at high speeds, and the craft bounce along the top of the water such that the motor discharges noise below and above the water surface. To recreation area visitors, this irregular noise seems to be more annoying than that of a standard motorboat that is cruising along the shoreline, even though the maximum noise levels may be similar for the two watercraft (approximately 80 to 90 dBA at 50 feet). Additionally, visitors who expect to experience natural quiet may consider the irregular noise of PWC more annoying, especially if the craft is operating in one location for extended periods of time.

WILDLIFE AND WILDLIFE HABITAT

GENERAL WILDLIFE HABITAT AND VEGETATION DESCRIPTION

With annual precipitation averaging 12 inches per year, the environment of Curecanti is best classified as semi-arid shrubland. In the majority of the recreation area, the plant community is dominated by big sagebrush mixed with rabbitbrush. Slight differences in elevation, moisture, or soil structure can result in visible differences in vegetation community composition. Tall cottonwood trees and lush undergrowth are associated with riparian areas along the Gunnison River and side drainages. In these areas, the narrowleaf cottonwood with its deep roots helps stabilize the riverbank while providing shade for understory plant growth. Intermittent drainages support juniper, gamble oak, and shrubs including serviceberry and wild rose. Higher elevation areas, such as the Soap Creek Arm, are characterized by scattered ponderosa pine, Douglas fir, and spruce trees. The landscape on the east side of the national recreation area has been altered by humans and is characterized by green pastures.

In the 1997 *General Management Plan*, Curecanti National Recreation Area identified and prioritized 17 primary natural resource inventories to be completed. By 2005, the park will complete vegetation mapping and surveys for vascular plants, birds, mammals, fish, amphibians, and reptiles.

MAMMALS

Common mammals include mule deer, elk, Rocky Mountain bighorn sheep, black bear, yellow-bellied marmot, skunk, porcupine, badger, long-tail weasel, least and Colorado chipmunks, and golden-mantled ground squirrels. Predators include mountain lion, bobcat, coyote, ringtail cats, and fox.

The habitats of most mammals in the area are found in the nearby forested or sagebrush shrublands where ample food supply exists. Deer, elk, and bighorn sheep occur mostly in habitat adjacent to the lake arms, in areas that have wake restrictions for watercraft that minimize craft-related noise. These species are not commonly found along the remainder of the Blue Mesa Reservoir shoreline, and would likely move back into upland or arm areas if disturbed by noise or watercraft activities. The potential exists for smaller wildlife that occupy areas close to the reservoir (such as squirrels, porcupines, and skunks) to be impacted by PWC noise.

BIRDS

There are approximately 225 species of birds documented in the area of Curecanti National Recreation Area (Hyde and Cook 1980). Common birds include the horned lark, black-capped chickadee, white-breasted nuthatch, dipper, American robin, mountain bluebird, hermit thrush, warbling vireo, western meadowlark, red-winged blackbird, pine siskin, black-billed magpie, common raven, and various jays, warblers, juncos, sparrows, finches, woodpeckers, and towhees.

Many species of waterfowl and shorebirds migrate through the Gunnison Basin region or remain as summer residents. Common water and shore birds found at Curecanti include the spotted sandpiper, ring-billed gull, and green-winged teal. Nesting areas are not found in areas of high PWC use, as aquatic and other vegetation is scarce along the majority of the shoreline due to water fluctuations. Nesting areas are more likely to be found further inland and in the narrow portions of the lake arms. Waterfowl and shorebirds that nest in these speed and wake restricted areas include killdeer, common snipe, mallard and common merganser. Great blue herons wade along the shoreline in these narrow lake arm areas as well.

Common raptors at Curecanti include red-tailed hawk, Swainson's hawk, golden eagle, bald eagle, and American kestrel. Great horned owls nest in the area and are common year-round, and flammulated owls are common in the summer months. Gunnison sage grouse, a unique species native to the region, are present in the sagebrush communities within Curecanti and adjacent lands.

Of the birds recorded in the recreation area, only four are federally or state listed as regionally threatened, endangered, or candidate species, including bald eagle, whooping crane, and yellow-billed cuckoo. The Gunnison sage grouse was also designated as a federal candidate species for listing under the *Endangered Species Act* on December 28, 2000. Four others including the Sandhill crane, peregrine falcon, Gunnison sage grouse, and long-billed curlew are listed as state special concern species. Special status species are discussed later in this section.

Within Curecanti National Recreation Area, five sites including Cooper's Ranch, Neversink, Morrow Point, Pine Creek, and Cebolla are monitored for bird presence and abundance. Each site has ten stations

(except for Cooper's Ranch which has six) based on specific vegetation type such as sagebrush, and Douglas fir/oak. At each station, birds are identified within six concentric zones and flyovers.

Most birds identified as having habitat within the study area have the ability to move from the shoreline if temporarily disturbed by noise or watercraft activities.

FISH

Construction of the dams along the Gunnison River has fundamentally altered the fisheries of the area through inundation, alteration of flows and water temperatures, and alteration of spawning habitat. However, Curecanti National Recreation Area provides one of the best cold-water fishing opportunities in the nation due primarily to Kokanee salmon in Blue Mesa Reservoir. Other game fish common to Curecanti include lake trout (Mackinaw trout), brook trout, rainbow trout, and brown trout. The Colorado Division of Wildlife (CDOW) maintains populations through stocking of game species. Due to seasonal water fluctuations, there is a lack of development of aquatic plant or benthic invertebrate communities to provide concentrated shoreline feeding areas for fish (CDOW 2002b). Instead, zooplankton is the main food source for sport fish in Blue Mesa Reservoir.

AMPHIBIANS, REPTILES, AND AQUATIC INVERTEBRATES

Snakes common to Curecanti include the smooth green snake, Great Basin gopher snake, garter snake, and striped whipsnake. A variety of lizards and salamanders are also found within Curecanti National Recreation Area. Breeding areas for lizards are generally in upland areas away from the shoreline, while primary habitat for amphibians would be in the narrow, inland portions of lake arms.

Blue Mesa Reservoir has not been surveyed for benthic invertebrates. Generally, the abundance and type of organisms present would depend on the water quality and habitat conditions within the reservoir. The shoreline of Curecanti has little to no benthic vegetation, so little habitat is available for aquatic invertebrates. Thus, the diversity and abundance of invertebrates along the shoreline is expected to be low, with most organisms associated with creek inflow areas and wetlands.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

WILDLIFE SPECIES

Species protected by the *Endangered Species Act* are listed by the U.S. Fish and Wildlife Service (USFWS) as federally threatened or endangered. In addition, USFWS lists candidate species that are considered for listing at a later date. While not protected under the *Endangered Species Act*, candidate species are also considered when analyzing impacts of actions that may potentially affect them.

A letter was sent by Curecanti staff to USFWS on September 12, 2002 requesting a list of federally threatened and endangered species that potentially could be affected by a special regulation providing for continued use of PWC on the flat-wake speed portions of Blue Mesa Reservoir. USFWS responded on October 16, 2002, with a list of the following five federally listed or candidate species: bald eagle (threatened), southwestern willow flycatcher (endangered), yellow-billed cuckoo (candidate), Canada lynx (threatened), and boreal toad (candidate) (USFWS 2002). No critical habitat was identified within 200 feet of the shore.

The Colorado Wildlife Commission maintains a list of special status species including state-listed threatened, endangered, or special concern species. The federally listed species mentioned above with the exception of the yellow-billed cuckoo are also given special status by the state. Other state listed species that may potentially be affected by the action at Curecanti include the greater Sandhill crane, Gunnison sage grouse, American peregrine falcon, and long-billed curlew. All of these species are listed as special concern species and therefore do not have protected status. However, they have been determined by the Colorado Wildlife Commission to be at risk of eventual threatened or endangered status. One state-listed (threatened) species that is protected is the Colorado River cutthroat trout, which is also federally listed as threatened. However, USFWS did not include any fish species in their list of federally listed species potentially affected by PWC management actions. Therefore, further description of Colorado River cutthroat trout at Curecanti is given in the state-listed species section of this chapter.

Wildlife species listed by both the U.S. Fish and Wildlife Service and the Colorado Wildlife Commission that could potentially be impacted by the action are listed in table 9. Only the Gunnison Sage Grouse has habitat near the shoreline of Curecanti National Recreation Area. The species are described in more detail in following sections.

FEDERAL SPECIES

Suitable habitat for bald eagle foraging exists along the entire length of Curecanti National Recreation Area, as the reservoir provides an ample food source for bald eagles in the area. Winter eagle activity is concentrated around the Gunnison River and the shorelines at Curecanti. Generally, bald eagles that nest on the Western Slope of Colorado tend to nest in large trees along rivers. However, due to the lack of sizable trees along the shoreline of Blue Mesa Reservoir, nesting on the shoreline is unlikely. Eagles are known to reside within and may nest near the canyon walls of Black Canyon. However, any nesting that may occur in the recreation area does not occur where PWC use is allowed at Curecanti.

TABLE 9: FEDERAL AND STATE LISTED WILDLIFE IDENTIFIED IN THE VICINITY OF CURECANTI NATIONAL RECREATION AREA

Common Name	Scientific Name	Federal Status	State Status*	Observed in National Recreation Area	Habitat Present Near Shoreline
Birds					
Bald eagle	*Haliaeetus leucocephalus*	T	T	X	
Yellow-billed cuckoo	*Coccyzus americanus*	FC			
American peregrine falcon	*Falco peregrinus anatum*		SC	X	
Greater Sandhill crane	*Grus Canadensis tabida*		SC	X	
Gunnison sage grouse	*Centrocercus minimus*	FC*	SC	X	X
Long-billed curlew	*Numenius americanus*		SC	X	
Mammals					
Canada lynx	*Lynx Canadensis*	T	E		
Amphibians					
Boreal Toad	*Bufo boreas boreas*	FC	E		
Fish					
Colorado River cutthroat trout	*Oncorhynchus clarki stomias*		SC	X**	

Source: USFWS 2002; Colorado Division of Wildlife 2000b.

E = Endangered Species; T = Threatened Species; SC = Special Concern Species, FC = Federal Candidate Species.

* Source: U.S. Fish and Wildlife Service 2000.

** Genetic purity of observed fish not determined. Hybridization with other trout is likely.

Willow flycatcher habitat typically consists of dense shrub and tree growth in riparian and/or wetland communities along drainages. At Curecanti, potential habitat for the species includes the riparian areas of inflow drainages and lake arms, but, according to the Natural Diversity Information System website (NDIS 2002), suitable habitat does not exist in the area. The existence of the southwestern willow flycatcher subspecies in Colorado has been debated and research is ongoing to determine which subspecies occurs in the region.

Curecanti is not a known breeding site for the species and it is likely that any individuals that may occur in the area do so during migration only.

In the western United States, yellow-billed cuckoo habitat consists of old growth riparian woodlands with dense understories, while in other portions of the country more open woodlands are adequate (Kingery 1998). In Curecanti, the locations of potential occurrence for this species would be in the riparian corridors of the inflow drainages and lake arms where PWC use does not occur. The yellow-billed cuckoo is designated as a non-game species within Colorado. As that designation applies, it is not legal to take, harass, or threaten the species. There are only infrequent non-breeding summer records of yellow-billed cuckoo occurrences within Curecanti (Andrews and Righter 1992, Hyde and Cook 1980), but there is no evidence of breeding by the species in Gunnison County (Kingery 1998).

Canada lynx occur at elevations of 9,000 to 14,500 feet in forests, meadow, or tundra environments. Lynx potentially could occupy higher elevation areas surrounding Curecanti National Recreation Area. The shoreline of Blue Mesa Reservoir is at an elevation well below that of suitable habitat for the species, so regular occurrences of lynx at the shoreline are unlikely.

Distribution of the boreal toad in Colorado is restricted to areas with suitable breeding habitat at elevations of 7,000 to 12,000 feet. This includes lakes, marshes, ponds, bogs or other wet areas within spruce-fir forests and alpine meadows with sunny exposure (CDOW 2002a). Suitable habitat surrounds Curecanti National Recreation Area (NDIS 2002); however, the shoreline of Blue Mesa Reservoir is not characterized by vegetated areas suitable for breeding habitat of the species. It is likely that the boreal toad occupies forested areas or alpine meadows outside of Curecanti.

The Gunnison sage grouse was not listed as a potentially affected species in the letter received from the USFWS. However, it is a federal candidate species and is known to occur along the shoreline in areas of PWC and other visitor use. This native to the Gunnison Basin was recognized in 2000 to have different coloration and mating rituals than the Northern sage grouse. The breeding population size is small, totaling only 4,000 individuals, with up to 3,000 of those believed to reside in Saguache or Gunnison counties, Colorado (BLM 2001). The birds nest in big sagebrush dominated communities from April to July. Within Curecanti, a historic Gunnison sage grouse lek occurs near the shoreline at the Stevens Creek campground.

The Colorado Division of Wildlife and park are currently engaged in monitoring programs for the Gunnison sage grouse lek (breeding) sites. These areas are counted during each of four 10-day periods beginning April 1 and ending on May 10. Inactive leks are visited at least twice during the breeding season. The numbers of male and female grouse are counted at several intervals throughout the visit and the high counts are recorded at the end of the observation period. Observers also record weather conditions, disturbances to grouse, behavior, and movements to and from the lek. The data is analyzed to determine high count for males, number of active leks, average number of males per lek, estimated female population, overall population, and a three year moving average of the number of males.

Gunnison sage grouse could be susceptible to PWC noise disturbance and shoreline use during the lek season (March – May 15), if this lek remains active. Additionally, if nesting habitat occurs in the vicinity,

Gunnison sage grouse could be affected by PWC use during the nesting season (April – July). Gunnison sage grouse occurs in other areas within Curecanti and immediately adjacent lands, but are not likely to be affected by PWC use.

STATE LISTED SPECIES

The American peregrine falcon was recently federally delisted, but remains a state species of concern. The falcon occupies a variety of habitats at elevations of 3,000 to 10,000 feet and usually nests in high cliff ledges. Peregrines are known to occur nearby in the Black Canyon of the Gunnison, especially near the Painted Wall area. They are less common in the immediate vicinity of Blue Mesa Reservoir, but have been recorded in the area (Andrews and Righter 1992, Hyde and Cook 1980).

The greater Sandhill crane occupies a variety of habitats including crops, grasslands, mudflats and riparian areas at 3,000 to 10,000 feet in elevation. The area along Curecanti National Recreation Area and the Gunnison River is considered to be suitable habitat for the species during migration, primarily in spring, but is not a known breeding area for the species (Kingery 1998, Andrews and Righter 1992). Sandhill cranes are most likely to occur along riparian areas in lake arms or inflow drainages or in agricultural areas surrounding the recreation area. The potential spring visits by the cranes does not coincide with the summer months when PWC are in use at the recreation area.

Habitat of the long-billed curlew includes croplands, grasslands, shrublands, and wetland and riparian areas at elevations of 3,000 to 5,000 feet. They are known to occur as springtime migrants throughout Gunnison County, including within the vicinity of Curecanti National Recreation Area (Andrews and Righter 1992). However, there is no evidence that they breed throughout most of western Colorado, including within Gunnison County (Kingery 1998). In Colorado, the long-billed curlew is primarily an eastern plains species.

The Colorado River cutthroat trout is a vulnerable state species of concern and is known to occur in the Gunnison River below Crystal Reservoir and in Black Canyon but not in Blue Mesa Reservoir. Water from Curecanti National Recreation Area flows into habitat for this species and therefore could affect the fish.

PARK SENSITIVE SPECIES

Curecanti contains a variety of species that park staff considers to be native species of concern. These include Gunnison sage grouse (discussed above), great blue heron, bighorn sheep, Gunnison's prairie dog, and black bear. The park has not yet completed a comprehensive identification and evaluation of all native species of concern.

The great blue heron is a summer resident of Curecanti National Recreation Area, and a substantial rookery exists directly above the high water line of Blue Mesa Reservoir near Coopers Ranch (Bio Environs 2001).

Historically, bighorn sheep ranged throughout the canyons of the Gunnison River and the surrounding mountainous regions. However, populations declined throughout the 1900s due to habitat conversion, competition and disease. Beginning in the 1970s, the CDOW reestablished a bighorn population in the area through transplanting animals. Sheep have been transplanted into various areas including Dillon Mesa, Lake Fork, and the Gunnison Gorge. The most recent release was to the Dillon Mesa herd in late 1995. Area herds did well until a particularly severe winter in 1978 resulted in high mortality. Since 1978,

the total local population count has fluctuated between 25 and 35 animals (Colorado Plateau Cooperative Ecosystems Studies Unit [CPCESU] 2002). Bighorn sheep at Curecanti tend to be mostly located in the lake arms where motorized watercraft are regulated by flat-wake speed zoning.

Prairie dogs live in short- to medium-height grass prairies and plateaus at moderate to high elevations. The Gunnison's prairie dog is generally centered around the Four Corners area. As with all prairie dog species, populations are much smaller than they were historically due to eradication, habitat loss, and disease. At Curecanti, Gunnison's prairie dogs inhabit the sagebrush grassland areas of the park away from the shoreline. Gunnison prairie dog populations in the vicinity of Blue Mesa Reservoir pose a concern due to the tendency of the animals to carry the bubonic plague.

Black bears occupy a variety of habitats including various forest types and shrublands. Black bears are known to occur at the park and are seen occasionally by visitors. They are not likely to den near the shoreline of Blue Mesa Reservoir, as the most plentiful shelter and food sources are located in forested areas and in Black Canyon.

PLANT SPECIES

According to the U.S. Fish and Wildlife Service, there are no federally listed plant species that would be affected by a special regulation providing for personal watercraft use at Curecanti National Recreation Area. Two sensitive plant species that occur in the park, skiff milkvetch and Gunnison milkvetch are listed by the Colorado Natural Heritage Program (CNHP) as globally and state critically imperiled and globally and state imperiled, respectively. The skiff milkvetch and the Gunnison milkvetch occur in dry upland sagebrush areas at elevations of approximately 7,500 to 8,500 feet (CNHP 2002). Populations within Curecanti could potentially be accessed by PWC users, but are also accessible by other means such as automobile. There are no sensitive shoreline plant species at Curecanti National Recreation Area.

SHORELINE VEGETATION

Blue Mesa Reservoir is a deepwater impoundment and does not have many areas of shallow water or shoreline vegetation. Gusty winds are common in Curecanti National Recreation Area and contribute to shoreline erosion. When the reservoir is at full pool, wave action from motorized watercraft or winds may affect shoreline vegetation. Fluctuating water levels prevent the establishment of areas of aquatic or shoreline vegetation. There are no sensitive shoreline vegetation communities along the Blue Mesa Reservoir shoreline.

VISITOR USE AND EXPERIENCE

Curecanti National Recreation Area is in a sparsely populated area of Colorado. The nearest cities are Gunnison, Montrose, and Grand Junction. The nearest large metropolitan area is Denver, located approximately 200 miles to the northeast. The Denver metropolitan area has a population of 2,155,259. The Front Range of Colorado (stretching from Pueblo in the south to Fort Collins in the north) is home to 3,563,000 million people; 474,988 people live in the Western Slope region (State of Colorado Department of Local Affairs 2001).

Approximately 1 million visitors use the recreation area's facilities annually. The peak season is from Memorial Day to Labor Day, with activities focusing on water based recreation and camping. While the national recreation area is open year-round, due to its high altitude setting, approximately half of the visits

occur in June, July and August. PWC use occurs almost exclusively during the hot summer months with some minimal use in May and September (NPS 2002e).

Two facilities within the Colorado State park system that provide water-based activities, Crawford and Ridgeway, are located within 120 miles of Gunnison. The closest national parks to Curecanti are Glen Canyon National Recreation Area (420 miles) and Lake Mead National Recreation Area (650 miles).

ANNUAL VISITOR USE

Annual recreation visitor data for 1995 to 2001 indicate that visitation is fairly stable (see table 10). Annual visitor numbers first reached over one million in 1983, and except for a drop in visitor numbers in 2001, have been between 960,000 and 1,125,000 yearly since then.

The recreation area is situated adjacent to the Black Canyon of the Gunnison National Park, and is en route for many people who tour the national parks in the region (for example, Mesa Verde National Park, Rocky Mountain National Park, Canyonlands National Park, Arches National Park) Based on ranger observation, most visitors to the recreation area are from Colorado (NPS 2002c).

Based on the data available, as well as discussions with park staff, no dramatic increase in park visitation is anticipated over the next 10 years. However, permanent resident population in surrounding cities and counties is projected to increase at a rate of 2.0% per year, and an increase in regional population could result in a comparable increase in visitation (State of Colorado Department of Local Affairs 2001). Gunnison County has a large number of summer residents and second homeowners who visit the recreation area on a regular basis.

MONTHLY VISITOR USE

Approximately 51% of the annual visitation occurs during June, July, and August, when PWC use is most prevalent. Based on monthly visitor statistics, an average of 4,947 people visit the recreation area each day in June, July, and August (NPS 2002e).

TABLE 10: AVERAGE ANNUAL VISITATION AT CURECANTI NATIONAL RECREATION AREA, 1995–2001

Year	Number of Visitors	Percent Change from Previous Year
1995	996,522	—
1996	1,017,256	+2.0%
1997	967,118	-4.9%
1998	973,652	+0.6%
1999	1,044,523	+7.2%
2000	1,022,320	-2.1%
2001	879,804	-13.9%
Average	**985,885**	**—**

Source: NPS Visitor Use Statistics website (NPS 2002e).

VISITOR ACTIVITIES

Curecanti National Recreation Area shares an eastern boundary with Black Canyon of the Gunnison National Park and stretches 60 miles along the Gunnison River corridor, and is surrounded by a patchwork of private land and hundreds of thousands of mostly undeveloped acres of Bureau of Land Management and Forest Service lands. This setting provides a character of stark isolation, with park development mostly occurring along U.S. 50. Three dams along the Gunnison River were constructed in 1965. There are three reservoirs along the Gunnison River within the recreation area – Crystal Reservoir, Morrow Point Reservoir, and Blue Mesa Reservoir. Because Crystal and Morrow Point Reservoirs lie deep within the canyon of the Gunnison River, boating there is restricted to hand-carried craft.

Blue Mesa Reservoir, which is 20 miles long and has 96 miles of shoreline, is the largest water body in the state of Colorado. Blue Mesa is divided into three basins – Iola, Cebolla, and Sapinero – all suitable for water-based recreation. Curecanti lies at 7,500 feet above mean sea level, and water temperatures remain quite cold year-round, restricting many water-based recreation activities to the warmer summer months. Water-related activities include the use of speedboats, personal watercraft, canoes, sailboats, sailboards, and kayaks. Other summer activities include fishing, sightseeing, photography, wildlife watching, swimming, hiking, backpacking, developed and backcountry camping, and picnicking.

Scenic U.S. 50 stretches east-west along the recreation area. Developed marinas, picnic areas, and boat ramps are accessible from the highway, and there are numerous undeveloped pullouts and overlooks.

NPS staff at Curecanti estimate that approximately 51,500 visitors in 2001 were boaters, shoreline visitors, or visitors to the campgrounds close to Blue Mesa Reservoir (less than 6% of the annual total) (LAW 2002). These visitors may be most affected by PWC use. Because personal watercraft use may affect visitors at beaches, trails, and campgrounds near the shoreline, these activities are discussed below. This discussion is centered on Blue Mesa Reservoir as that is the only reservoir in the recreation area where PWC use was allowed until November 6, 2002.

Camping

There are 14 campgrounds within the recreation area. The lakeshore campgrounds that are accessible via boat or personal watercraft at Blue Mesa Reservoir are listed below.

- Stevens Creek – 54 sites on Blue Mesa Reservoir with boat ramp and fishing access
- Elk Creek – 179 sites (40 under construction) located on the shore of Blue Mesa Reservoir in treeless, sagebrush, and mesa country. Sixteen walk-in sites and 15 pull-through sites, marina and boat ramp
- Lake Fork – 87 sites, most are paved, 16 pull through sites, 5 walk in sites, on Blue Mesa Reservoir with marina and boat ramp
- Ponderosa – Located at end of Soap Creek Arm of Blue Mesa Reservoir, with 9 walk in and 20 drive in sites with a boat ramp

Lakeshore campsites are often full, especially during July and August. All of the lakeshore campgrounds have boat launch areas; thus, depending on water levels, there is generally boating activity concentrated near these camping areas. Record high numbers of campers (including tent and RV camping) occurred in the late 1980s, with 120,000 overnight stays per year. In the last five years, overnight stays have averaged

approximately 72,000 per year (NPS 2002e). Many overnight visitors use RVs and come to the reservoir to fish for extended periods of time. Some visitors spend the entire summer around the reservoir. There are two private campgrounds near the recreation area, and since there is a two-week maximum stay at a campsite within Curecanti, many individuals move back and forth from the private campgrounds to the park campgrounds, fishing daily.

Fishing

Fishing is one of the primary activities at Curecanti, as the recreation area provides some of the best cold-water fishing opportunities in the nation. This is due primarily to the Kokonee salmon fishery occurring in Blue Mesa Reservoir. Federal and state fish hatcheries stock over three million fish in Curecanti's reservoirs each year. Brown and rainbow trout are common fish in Curecanti. Mackinaw (lake) trout, which can weigh more than 40 pounds, are also found in deep water habitats in Blue Mesa. Both fishing from boats and shoreline fishing are popular at Blue Mesa although the majority of angling success occurs from boats.

Hiking/Backpacking/Wilderness Experience

There is one designated hiking trail along the northern shoreline of Blue Mesa Reservoir at Dillon Pinnacles. The pinnacles are the dominant geologic feature along the reservoir, and this trail is very popular, offering spectacular views of Blue Mesa Reservoir, the distant San Juan Mountain peaks, and the weirdly eroded volcanic pinnacles. Access to Dillon Pinnacles is off U.S. 50, six miles west of the Elk Creek Visitor Center. The trail ascends 600 feet, in a direction away from the reservoir. Backcountry camping opportunities exist on the south side of Blue Mesa Reservoir, especially between Iola and the Cebolla Arm where the shoreline does not have road access. Backcountry camper numbers have fluctuated dramatically, from 1,500 in 1981 to 49 in the year 2000. During the 10-year period between 1989 and 1999, there was an average of 710 backcountry campers per year, declining to 49 backcountry campers in 2000, and 113 in 2001 (NPS 2002e). The lake arms generally provide recreational opportunities that are more serene and less crowded than that of the main body of Blue Mesa.

Shoreline Use

Roads and hiking trails provide access to much of the Blue Mesa shoreline, ranging from sand beaches to rocky beaches, to cliffs and canyons. On the west end of the reservoir, the south shoreline is accessible by auto and foot between Blue Mesa Dam and Middle Bridge, and the north shoreline is accessible by auto and foot between the dam and Ponderosa campground. Most of the north shoreline from Middle Bridge to the east end of the reservoir at Lake City Bridge is accessible, and access continues between the Lake City Bridge and Iola on the southeast shoreline of the reservoir. Access points include undeveloped pullouts, trails, developed parking, picnic areas, campgrounds and boat launch areas.

Popular day-use areas along the shore are the area just south of the Lake City Bridge off Highway 149 and just west of the north end of the Lake City Bridge along U.S. 50. Due to the protected, cove nature of the site, Dry Creek picnic ground is a popular day-use area. Activities include picnicking, swimming, PWC use, dry-land water-ski starts, and cliff diving west of the Dry Creek beach area. There can be 30 to 40 people and 5 or 6 PWC in this area on a summer weekend day (NPS 2002c). When water levels are high, the windsurfing beach near the East Elk Creek campground sees a lot of activity – swimming, fishing, windsurfing, PWC use and picnicking.

Swimming

Swimming is allowed in the reservoir; however, there are no "designated" swim beaches within the recreation area and swimming is not permitted from docks, launch ramps or unanchored boats. Swimming is not allowed 100 feet from marinas, docks, anchorages, or between buoy lines above dams. Swimming is not allowed 100 feet from Lake City, Middle, and Lake Fork Bridges. Scuba and snorkeling are permitted only in waters open to powerboats, and prohibited within marina and docking areas.

Concessions

There are two marinas operated by concession. Services include restaurants, showers, groceries, fishing supplies, slip rental, boat rental (aluminum fishing boats, pontoon boats, sailboats, speed boats and personal watercraft), gas sales, boat repairs, tour boat services, boat sales and boat mooring.

General Watercraft Use (Motorboats, Canoes, and Kayaks)

Watercraft use has occurred on Blue Mesa Reservoir since the reservoir was created in 1965 with fishing and recreational boating the main boating activities.

Based on creel surveys conducted by the Colorado State Division of Wildlife in 2001, approximately 14,635 boats used Blue Mesa Reservoir during the May to October season (NPS 2002c). The largest group of motorized watercraft using the reservoir is fishing boats. In 2002, 1,160 annual boating permits were issued for Curecanti, and 4,137 two-day to two-week permits were issued. All motorboats, including personal watercraft, are required to purchase permits. During a holiday weekend, such as Fourth of July, up to 200 boats may occur on the reservoir at any one time. The average number of boats estimated per day on Blue Mesa Reservoir during a typical summer season day is 122 based on park staff observations and CDOW creel surveys (1993–2001).

Kayakers, canoeists and sailors also visit the recreation area, but make up a small percentage of lake users. Due to the cold temperature of the water and the common high afternoon winds, canoeing and kayaking is concentrated along shorelines and in the narrower arms of the reservoir, and east of the Lake City Bridge. Windsurfing is most popular at Bay of Chickens, where 4 or 5 windsurfers can be found on a summer weekend day, but windsurfing activity has been declining (NPS 2002c).

There are designated, paved launch ramps at Lake Fork Marina, Elk Creek Marina, Ponderosa, Stevens Creek, and Iola. When lake levels are low, some of these designated ramps are not usable.

PWC Use

Park staff have observed personal watercraft at Curecanti since their introduction in the 1980s, and in particular since the summer of 1995, when PWC were available for rental from a park concessioner. Although an Elk Creek Marina concessioner has had three to four PWC available for rent for the last seven years, the average PWC users are local day visitors who own their own PWC. A registration survey mailed to 1,000 vessel users requesting an annual permit in 2000 revealed that 0.69% of the 400 respondents were PWC users (NPS 2000d). Based on ranger observation, most PWC users are from Colorado.

Within Curecanti National Recreation Area, and until November 6, 2002, PWC use was allowed only on the main body and arms of Blue Mesa Reservoir. The *Superintendent's Compendium* (NPS 2002g) dictates that no personal watercraft are permitted on Crystal or Morrow Point Reservoirs due to horsepower restrictions, and no motorized vessels are permitted east of Beaver Creek. Areas designated as flat-wake speed zones for all vessels are Elk Creek and Lake Fork marinas, narrow portions of Lake Fork, Soap Creek, West Elk and Cebolla arms, Dry Creek cove, Bay of Chickens, Iola boat ramp, Stevens Creek ramp and Old Stevens boat ramp. Upstream from Lake City Bridge to Beaver Creek is a designated flat-wake area.

PWC use on the main body of Sapinero or Cebolla Basins was limited prior to the closure due to undesirable conditions created by common high winds. Most PWC use occurred between Elk Creek and Lake City Bridge. Popular, high-PWC-use areas included the east Iola Basin south of Highway 149, where there are several access points along a shore with a shallow beach; Dry Creek picnic area – a protected cove with traditional use by local visitors; and the Soap Creek Arm accessed from the Ponderosa Campground and the Lake Fork Marina. This higher usage was consistent with the launch locations and protected water. Some PWC activity occurred near the Elk Creek Marina launch area, and around "Sometimes Island," the small island near Willow Creek and Old Stevens. Few PWC operators traveled the entire length of the lakeshore due to the long distance, rough waters, and potential for changing weather.

PWC use occurred primarily during June, July, and August. The peak number of personal watercraft operating in the recreation area on a summer holiday is 16 per day, but is generally nine or less on a non-holiday, typical summer season day (NPS 2002d). The low PWC numbers are primarily a result of the cold water temperature, cool ambient air temperature, changeable weather conditions, and heavy winds and wave action.

The average PWC trip within Curecanti National Recreation Area lasts about two hours (with wetsuit) from mid-morning to early afternoon except when weather conditions are more favorable. PWC users cruise and sometimes race along the shoreline, explore the rock cliffs up close, jump the wakes of other boats, and travel to beach destinations to spend the day or afternoon. A small number of visitors use PWC to fish. Generally, PWC activity ends mid-afternoon due to winds and rough conditions, except in the protected coves.

Regional PWC Use

Based on ranger observation, most PWC users at Curecanti are from Colorado. There has been an increase of at least 10% in visitors from the Front Range in the last three years. This increase is likely a result of more stringent regulations in Front Range water recreation areas, including the closure of several regional reservoirs due to recent drought conditions. Gunnison County also has a large number of summer residents and second homeowners who visit the recreation area on a regular basis (NPS 2002c). In addition, Colorado State Parks receive more than 11 million visitors annually, with 18 of the 40 state parks allowing PWC use, increasing the potential for overcrowding and the likelihood of Front Range visitors seeking other PWC use areas.

VISITOR SATISFACTION

Generally, there is very little information specific to PWC use and visitor concerns. Information gathered from a voluntary survey of 185 visitors requesting vessel registration in 2000 (NPS 2000d) indicated that:

- Forty respondents were not aware of problems with PWC use.
- Ninety respondents would recommend limits on time and location of use.
- Seven respondents recommend opening areas where PWC could operate above flat-wake speed.

VISITOR CONFLICT AND VISITOR SAFETY

RELATED FEDERAL AND STATE PWC REGULATIONS

Prior to November 6, 2002, the use of PWC within the Curecanti National Recreation Area was authorized, except in areas restricting vessels, which include personal watercraft. Operators of personal watercraft are subject to all applicable Federal and state laws, as described in the "Alternatives" chapter.

The Curecanti *Superintendent's Compendium* (NPS 2002g) includes boating provisions that outline speed limits, wake zones, use areas, and prohibited areas.

PWC-RELATED VIOLATIONS AND CONFLICTS WITH OTHER VISITORS

Many of the activities undertaken by visitors to Curecanti National Recreation Area are compatible. For example, swimming, canoeing, fishing, and picnicking are all possible along the shoreline and produce little or no conflict between visitors. However, boating near swimmers, fishermen, and non-motorized vessels can pose a safety conflict for both parties, and as discussed under "Soundscapes," noise generated by personal watercraft can also affect visitor experiences.

Conflicts between PWC operators and other visitors have been documented through incident reports, and a few complaints about PWC activity received by the superintendent from both bank and boat fishermen. Most complaints are about wake violations. No PWC accidents have been reported in the last five years. Boating accidents and violations at Curecanti National Recreation Area for 1998–2002 are as follows:

2002: 2 boating accidents (0 were PWC); 15 boating violations (2 were PWC)

2001: 7 boating accidents (0 were PWC); 5 boating violations (1 was PWC)

2000: 4 boating accidents (0 were PWC); 8 boating violations (0 were PWC)

1999: 5 boating accidents (0 were PWC); 8 boating violations (3 were PWC)

1998: 6 boating accidents (0 were PWC); 14 boating violations (3 were PWC)

Although there have only been 9 citations of PWC in the last five years, the share of PWC citations is disproportionately large. In this five-year period, PWC account for less than 6% of total watercraft, and over 20% of all watercraft citations. Boating violations only include infractions for which citations were issued. Figures do not include verbal or written warnings. The biggest infraction was violation of flat-wake speed restrictions, especially in marinas. There have been one or two reported incidents involving PWC per year, mostly property damage from vessels grounding or wind related swamping. Curecanti currently has six permanent law enforcement staff and two boats. Generally, one boat with one person is on the reservoir daily during daylight hours in the summer season (NPS 2002c).

PWC have the most potential for conflicts with other motorboats, fishermen, and shoreline users because both user groups concentrate in the same areas. Areas of potential conflict are similar to areas of current conflict, at high PWC use areas such as the Iola Basin at Highway 149, Dry Creek picnic area, the Soap Creek Arm, the marinas, and around "Sometimes Island."

CULTURAL RESOURCES

HISTORICAL BACKGROUND

As early as 10,000 years ago, this area appears to have supported a series of human adaptations to desert, plateau, and mountain conditions. Paleo-Indian Tradition dated from pre-9,000 B.C. and 5,000 B.C. In about 6,500 B.C. there was a dual emphasis with the addition of gathering plant foods. This coupling of food gathering and hunting successfully continued in the Upper Gunnison Basin until Native American and Euro-American contact (NPS 1994).

The Archaic period with its hunting adaptation is represented in the park's archeological record from approximately 4,000 B.C. through A.D. 1. There also appears to be considerable evidence of aboriginal occupation dating from approximately A.D. 400–1600. The first evidence of an Indian group in the Upper Gunnison Basin, which was recognized and named by Euro-Americans, is that of the Utes who migrated in to the Colorado area from the Great Basin at A.D. 1200–1300 (NPS 1994).

Artifacts and radiocarbon dates collected from the area of the park range from 8,000 B.C. until about A.D. 1,500 and appear to document essentially continuous intermittent use of the Upper Gunnison Basin since the end of the Pleistocene. The historic period for Native Americans in western Colorado begins with first written account of contact with Ute groups and ends in approximately 1881 with their movement to reservations. The park also contains many unrecorded sites reflecting late 19th century Euro-American activity including small-scale ranching, mining, and logging as well as construction camps that supported expansion of the railroad (NPS 1994).

The prehistoric and historic stories of human culture in the Curecanti area are recorded in the traces and tracks left by Native Americans, miners, railroaders and ranchers. These document the human struggle to survive as well as how changing human value systems, economic, social, and technological changes and the importance of water have shaped the use and character of the land and its people. Cultural history contains archeological examples of some of the oldest villages found in North America (predating the building of the pyramids). The narrow-gauge railroad exhibited in Cimarron graphically portrays the story of technology's effects of shaping people and using land; the agony and difficulties of building track in narrow canyons in winter with little benefit of sun. Visitors to the lake arms on the Blue Mesa are provided access to a cultural resource that evokes a pioneer history within this landscape (NPS 1997).

ARCHEOLOGICAL RESOURCES

Sporadic archeological research in the Curecanti area began as early as the 1930s but the first systematic research was prompted in 1962 by the Bureau of Reclamation plans to construct the three dams along the Gunnison River. Surveys in the area of Blue Mesa Reservoir identified ten sites with eight below the proposed high water line behind the Blue Mesa Dam that were believed to reflect short term occupations by nomadic Indian groups. Under Executive Order 11593 surveys were under taken in 1976 with the University of Colorado that identified another 130 archeological sites, most within the vicinity of Blue Mesa Reservoir. Examinations in the late 1970s with both University of Colorado and NPS staff from the Midwest Archeological Center (MWAC) uncovered additional features including the remains of an

isolated hearth that generated a radiocarbon date of approximately 8,000 B.C. In 1981 the Curecanti Archeological District was nominated to the National Register of Historic Places. Between 1980 and 1984 MWAC undertook five seasons of construction-related research. Construction-related research projects were under taken between 1991 and 1992 by MWAC as well as by Powers Elevation Company and Alpine Archeological Consultants. A mix of new sites, isolated finds, and previously recorded sites were inventoried. Two formerly unrecorded sites were added to the Curecanti Archeological District nomination (NPS 1994).

SOCIOECONOMIC ENVIRONMENT

A detailed description of the socioeconomic environment affected by PWC use at Curecanti National Recreation Area is provided in the report *Economic Analysis of Personal Watercraft Regulations in Curecanti National Recreation Area* (LAW 2002). The closest towns to Curecanti National Recreation Area are Gunnison and Montrose, Colorado. The economy of Gunnison is diverse, with an emphasis in educational and medical facilities, recreation, and ranching. Montrose depends on retail, service, and manufacturing industries for its economic base. Tourism is a major industry for the region, with visitors coming year-round to enjoy activities such as skiing, rafting, fishing, kayaking, camping, hiking, and sightseeing. Recreational visitation to Curecanti in 2001 was an estimated 879,804 people, with peak visitation from June to August. Approximately 52% of the annual visitation to the recreation area occurs during June, July and August.

A PWC rental concession is located on Blue Mesa Reservoir. One business that sells PWC and one that services PWC were identified in Montrose. A business that sells PWC and one that services PWC were identified in Gunnison, and two sales shops with revenues related to Curecanti National Recreation Area were identified in Grand Junction.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

Curecanti currently has four permanent law enforcement staff positions, two subject to furlough. Through an agreement with the Bureau of Reclamation, seven additional seasonal rangers for homeland security are integrated into the park's normal ranger patrol functions. However, this is not part of the park's base operations and could be discontinued at any time. During the summer season, there are usually two rangers on duty at any given time, with the exception of early mornings, which normally have only one ranger on duty.

Boat patrols on Blue Mesa Reservoir are conducted on a regularly scheduled basis with either morning or afternoon (sometimes both) patrols for one to two hours. Search-and-rescue patrols are infrequent and occur as needed. Generally, on the reservoir, Curecanti rangers are the only local agency with vessels that provide routine patrols and deal with enforcement issues and emergencies. The one exception is Colorado State Parks, which may be on the water once over the course of a summer for one weekend.

ENVIRONMENTAL CONSEQUENCES

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the National Park Service: the *National Environmental Policy Act* (NEPA) of 1969, and its implementing regulations; the *National Parks Omnibus Management Act of 1998* (NPOMA); and the NPS *Organic Act of 1916*.

1. The *National Environmental Policy Act* is implemented through regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). The National Park Service has in turn adopted procedures to comply with the act and the CEQ regulations, as found in *Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (2001a), and its accompanying handbook.

2. The *National Parks Omnibus Management Act of 1998* (NPOMA) (16 USC 5901 et seq.) underscores the *National Environmental Policy Act* in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case.

   The *Omnibus Act* directs the National Park Service to obtain scientific and technical information for analysis. The NPS handbook for *Director's Order #12* states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (sec. 4.4).

   Section 4.5 of *Director's Order #12* adds to this guidance by stating "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the NPS will follow the provisions of the regulations of CEQ" (40 CFR 1502.22). In summary, the Park Service must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

3. The 1916 NPS *Organic Act* (16 USC 1) commits the Park Service to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

GENERAL METHODOLOGY FOR ASSESSING IMPACTS

While much has been observed and documented about the overall effects of personal watercraft on the environment, as well as public safety concerns, site-specific impacts under all conditions and scenarios are difficult to measure and affirm with absolute confidence. Since personal watercraft were introduced in parks, data collected and interpreted about them and their effects on park resources relative to other uses and influences are difficult to define and quantitatively measure, despite monitoring.

Recognizing this dilemma, the interdisciplinary planning team created a process for impact assessment, based upon the directives of the *DO #12 Handbook* (sec. 4.5(g)). National park system units are directed to assess the extent of impacts on park resources as defined by the context, duration, and intensity of the effect. While measurement by quantitative means is useful, it is even more crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists. With interpretation, one can ascertain whether a certain impact intensity to a park resource is "minor" compared to "major" and what criteria were used to base that conclusion.

To determine impacts, methodologies were identified to measure the change in park resources that would occur with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions, both adverse and beneficial, of the various management alternatives.

Potential impacts are described in terms of type (Are the effects beneficial or adverse?); context (Are the effects site-specific, local, or even regional?); duration (Are the effects short-term, lasting less than one year, or long-term, lasting more than one year?); and intensity (Are the effects negligible, minor, moderate, or major?). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document.

Each alternative is compared to a baseline to determine the context, duration, and intensity of resource impacts. For purposes of impact analysis, the baseline is the reinstatement of personal watercraft use and current management projected over the next 10 years (alternative A). In the absence of quantitative data, best professional judgment was used to determine impacts. In general, the thresholds used come from existing literature on personal watercraft, federal and state standards, and consultation with subject matter experts and appropriate agencies.

In addition to establishing impact thresholds, the national recreation area's resource management objectives and goals (as stated in the "Purpose of and Need for Action" chapter) were integrated into the impact analysis. In order to further define resource protection goals relative to personal watercraft management, the park's *Strategic Plan* (NPS 2001c) was used to ascertain the "desired future condition" of resources over the long term. The impact analysis then considers whether each management alternative contributes substantially to the park's achievement of its resource goals, or would be an obstacle. The planning team then considered potential ways to mitigate effects of personal watercraft on park resources, and the alternatives were modified accordingly.

For the purposes of analysis, the following assumptions are used for all impact topics:

Short-term impacts: Those impacts occurring from PWC use in the immediate future (per trip through a single season of use, usually 1 to 6 months).

Long-term impacts: Those impacts occurring from PWC use over several seasons of use through the next 10 years.

Direct impacts: Those impacts occurring from the direct use or influence of PWC use.

Indirect impacts: Those impacts occurring from PWC use that indirectly alter a resource or condition.

Impact Analysis Area: Each resource impact is assessed in direct relationship to those resources affected both inside and outside the park, to the extent that the impacts can be substantially traced, linked, or connected to PWC use inside park boundaries. Each impact topic, therefore, has an impact analysis area relative to the resource being assessed, and it is further defined in the impact methodology.

CUMULATIVE IMPACTS

The CEQ regulations to implement the *National Environmental Policy Act* require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Curecanti and, if applicable, the surrounding region, as discussed in the "Purpose and Need" section.

IMPAIRMENT ANALYSIS

The NPS *Management Policies 2001* require an analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as established by the *Organic Act* and reaffirmed by the *General Authorities Act*, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within a park system unit, that discretion is limited by the statutory requirement that the agency must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The following process was used to determine whether the various PWC management alternatives had the potential to impair park resources and values:

1. The park's authorizing memorandum of agreement, the *General Management Plan* (NPS 1997), the *Strategic Plan* (NPS 2001c), and other relevant background were reviewed with regard to the unit's purpose and significance, resource values, and resource management goals or desired future conditions.

2. PWC management objectives specific to resource protection goals at the park were identified.

3. Thresholds were established for each resource of concern to determine the context, intensity and duration of impacts, as defined above.

4. An analysis was conducted to determine if the magnitude of impact reached the level of "impairment," as defined by NPS *Management Policies*.

The impact analysis includes any findings of impairment to park resources and values for each of the management alternatives.

PWC AND BOATING USE TRENDS

CURRENT USE ESTIMATES

PWC use trends were identified to determine direct and indirect impacts of PWC management strategies on park resources. Boating use trends, which are indicative of visitor use trends such as fishing, were researched to help assess cumulative effects. Current and future use estimates were determined for the entire reservoir based on Curecanti staff observations during the 2000 and 2001 summer seasons and the annual Colorado Division of Wildlife (CDOW) creel surveys.

PWC and boating use was observed and averaged by park staff between June 30, 2001 and July 8, 2001, a peak use holiday week, to derive an estimate of 3 to 9 PWC. However, because the Fourth of July fell between two weekends that year, park staff indicated that holiday weekend use was distributed over two weekends, rather than just one, reflecting less daily use than normal during a peak holiday weekend. Gasoline prices were also high during that period and the weather was cold and rainy affecting outdoor activities. Because of these factors, park staff indicated 9 PWC per day was more reflective of a typical summer day, rather than a holiday (NPS 2002d).

Boating estimates were derived from another reputable source of data. The Colorado Division of Wildlife in cooperation with Curecanti conducts fishing creel surveys at Blue Mesa Reservoir each year. From this survey information, the number of boats for the May through October use season was estimated at approximately 14,635 boats in 2001 (NPS 2002d). This annual boating number was distributed throughout the summer/fall boating season based on park staff observations and the percentage of annual park visitation that occurred monthly from May to October (NPS 2002e; NPS Visitor Use Statistics). The daily and annual boat and PWC estimates for peak use days, typical summer days, medium use days, and low use days are provided in table 11. Peak daily use is necessary to calculate water quality impacts; annual use is required for air quality impacts. These figures will be referenced in these respective sections. The annual boat use is estimated to be slightly less than the creel survey, based on park observations.

FUTURE USE TRENDS

PWC and boating use at Curecanti was determined by evaluating trends in PWC and boating registrations for the state of Colorado and by analyzing annual percentage changes in the local region and Front Range population because much of the use at Curecanti is from Colorado. These trends were also compared to recreation visits over the past decade to determine if population growth was affecting visitation.

PWC and Boating Trends. The growth in state of Colorado boating registrations from 1995 to 1999 was approximately 3.3% annually as noted in table 12. PWC registrations increased dramatically until 1996 and then the rate of increase began to decline steadily until 2002 when annual PWC registrations declined by 1%. Colorado appears to be following the national trend in PWC growth as noted in the "Summary of Research on the Effects of Personal Watercraft" section, only somewhat delayed. Based on registration data, PWC use is beginning to decline after a decade of growth in Colorado.

Population and Visitation Trends. Based on state demographic data, average annual increases in population for Colorado, Region 10, and the Front Range of Colorado (major metropolitan areas in the state) are projected to be approximately 1.7% to 2.0% for the years 2000 through 2015. Percentage growth in population by five-year periods is presented in table 13. Region 10, which includes the counties surrounding Curecanti National Recreation Area, is projected to experience 2% population growth per year. However, these figures do not include second home growth and summer residents that are not classified as Colorado residents that appear to park staff to be increasing at a greater rate yearly.

TABLE 11: DAILY AND ANNUAL WATERCRAFT USE

Visitor Use Season	Days per year	Total Boats/day	Total Boats/year	Total PWC/day	Total PWC/year
Peak use days (July 4th and Labor day)	6	200	1,200	16	96
Typical summer season day (July - August)	58	122	7,076	9	522
Medium use days (June and September)	58	85	4,930	3	174
Low use days (October)	31	20	620	0	0
TOTAL	**153**	**NA**	**13,826**	**NA**	**792**

Source: Park staff observations in 2001, 2002; CDOW Blue Mesa Reservoir Creel Survey (1993–2001).

NOTE: 13,826 total boats + 792 total PWC = 14,618 total boats and PWC per year.

NOTE: 200 boats + 16 PWC = 216 boats and PWC per peak use day.

TABLE 12: COLORADO BOAT AND PWC REGISTRATION STATISTICS

Year	Total Boats	Annual Percent Change (Boats)	PWC	Annual Percent Change (PWC*)
1994	87,989	—	5,587	—
1995	90,858	3.2%	7,261	30%
1996	95,140	4.7%	10,177	40%
1997	98,055	3.1%	12,348	21%
1998	100,380	2.4%	13,987	13%
1999	103,673	3.2%	15,290	9%
2000	104,500	1.2%	16,666	9%
2001	104,946	0%	17,316	4%
2002	101,948	-0.4%	17,184	-1%

Source: Colorado State Parks.

* Rounded to nearest whole number.

TABLE 13: COLORADO PRELIMINARY POPULATION PROJECTIONS AVERAGE ANNUAL PERCENT CHANGE

Year	State	Region 10[a]	Front Range[b]
1995–2000	2.1	2.7	2.6
2000–2005	1.7	2.0	1.7
2005–2015	1.7	2.0	1.5

Source: Colorado Department of Local Affairs, Demography Section.

a. Region 10 is composed of six counties in the vicinity of Curecanti: Delta, Gunnison, Hinsdale, Montrose, Ouray, and San Miguel.

b. Front Range of Colorado includes the metropolitan areas of Denver, Boulder, Fort Collins, Colorado Springs, and Pueblo.

Although population has continued to grow, recreation visits at the reservoir have fluctuated between a high of 1,103,542 in 1993 to a low of 879,804 in 2001, with a steady decline between 1999 and 2001.

PWC and Boating Growth Rates. Based on the previous population and PWC/boating registration information, a 2.0% growth rate in PWC use at Curecanti was estimated between 2002 and 2012. This growth rate appears reasonable assuming the 1.7% to 2.0% projected change in local, regional, and state population growth, but anticipated decreases in growth of PWC use, (similar to national trends and as evidenced by the recent decrease in state registrations) and the relatively flat annual visitation figures. Although not quantified in this analysis, the 2.0% rate also acknowledges the continued second home growth that may bring additional boating and PWC users to the park (NPS 2002c). Assuming a 2% growth rate, PWC peak daily use would increase from 16 PWC in 2002 to 20 PWC in 2012 in alternative A and B (table 14).

Boating growth rates were determined by comparing the average annual percentage change in population for Region 10 and the Colorado Front Range for 1995–2000 (two figures averaged = 2.65%) with the average annual increase in boating registration (2.5%). Using projected population figures for 2000–2005 and 2005–2015, a similar relationship in growth between population and boat registrations was estimated. An annual 1.85% increase is anticipated in the combined population of Region 10 and the Front Range of Colorado from 2000–2005, decreasing to 1.75% from 2005–2015. Because population growth is increasing at a lower rate, it was determined that boating (as evidenced by recent boating registrations) would decrease in a similar manner.[3] Using this method, the increase in boating use in 2002–2005 and 2005–2012 was estimated as 1.75% and 1.66%, respectively. At these rates, peak day boat use would increase from 200 boats in 2002 to 236 boats in 2012 (table 14).

WATER QUALITY

Most research on the effects of personal watercraft on water quality focuses on the impacts of two-stroke engines, and it is assumed that any impacts caused by these engines also apply to the personal watercraft powered by them. There is general agreement that two-stroke engines (and personal watercraft) discharge a gas-oil mixture into the water. Fuel used in PWC engines contains many hydrocarbons, including BTEX. PAH also are released from boat engines, including those in personal watercraft. These compounds are not found appreciably in the unburned fuel mixture, but rather are products of combustion. Discharges of all these compounds — BTEX and PAH — have potential adverse effects on water quality. A common gasoline additive, MTBE is not used in gasoline sold in Colorado (USDOE 2002).

3. For example, the percentage change in the averaged Region 10 and Front Range population growth rate between 1995 and 2000 (2.65%) and 2000 and 2005 (1.85%) is 69.8% (1.85/2.65 = .698). Multiplying 69.8% by the average percentage change in boating registration (.698 × 2.5) results in the 1.75% annual increase in boating between and 2002 and 2005.

TABLE 14: WATERCRAFT PROJECTIONS – PEAK DAILY USE

Year	PWC	Other Boats	Total
2002	16	200	216
2012	20	236	256

A typical conventional (i.e., carbureted) two-stroke PWC engine discharges as much as 30% of its fuel unburned directly into the water (NPS 1999; CARB 1999). At common fuel consumption rates, an average two-hour ride on a personal watercraft may discharge 3 gallons of fuel into the water (NPS 1999). According to data from the California Air Resources Board, two-stroke PWC engines may consume 5 to 10 gallons of fuel per hour, of which up to 3.3 gallons per hour may be discharged unburned (CARB 1998b). (As described in appendix A, an estimated discharge rate of 3 gallons per hour is used in the water quality impact calculations.)

As described below, hydrocarbon discharges to water are expected to decrease substantially over the next 10 years due to mandated improvements in engine technology (EPA 1996a, 1997).

GUIDING REGULATIONS AND POLICIES

The U.S. Environmental Protection Agency has developed national recommended ambient water quality criteria for approximately 120 priority pollutants for the protection of both aquatic life and human health (through ingestion of fish/shellfish or water) (EPA 1999a). These criteria have been adopted as enforceable standards by most states. The Environmental Protection Agency has not established any criteria for the protection of aquatic life for any of the PWC-related compounds stated above. For the human health criteria, however, the Environmental Protection Agency has established criteria for benzene, ethylbenzene, toluene, and several PAH compounds. There are no criteria for xylene.

The NPS *Management Policies 2001* state that the Park Service will "take all necessary actions to maintain or restore the quality of surface waters and ground waters within the parks consistent with the *Clean Water Act* and all other applicable federal, state, and local laws and regulations" (sec. 4.6.3).

The parameters collected by Curecanti as part of the a fixed frequency water quality program were taken in context to PWC emissions. None of the parameters collected demonstrate ambient concentrations or establish direct or indirect toxic effects of PWC emissions on reservoir biota and are collected only to address state requirements under the *Clean Water Act*.

Curecanti does not have sufficient quantitative water quality data documenting the effects of PWC. To address water quality impacts potentially resulting from reinstated PWC use, water quality benchmarks were used in the absence of unit-specific data as a basic principle to guide the analysis.

Simply stated, a water quality standard defines the water quality goals of a waterbody by designating uses to be made of the water, by setting minimum criteria to protect the uses, and by preventing degradation of water quality through antidegradation provisions. The antidegradation policy is only one portion of a water quality standard. Part of this policy (40 CFR 131.12(a)(2)) strives to maintain water quality at existing levels if it is already better than the minimum criteria. Antidegradation should not be interpreted to mean that "no degradation" can or will occur, as even in the most pristine waters, degradation may be allowed for certain pollutants as long as it is temporary and short term (NPS 2001b).

Other considerations in assessing the magnitude of water quality impacts is the effect on those resources dependent on a certain quality or condition of water. Sensitive aquatic organisms, submerged aquatic

vegetation, riparian areas, and wetlands are affected by changes in water quality from direct and indirect sources.

While many parks do have established water quality monitoring programs, the specific organic compounds emitted from personal watercraft are not systematically measured. In the absence of park-specific data, available water quality benchmarks or criteria and estimated discharge rates of organics were used as the basic tools to address water quality impacts potentially resulting from PWC use.

METHODOLOGY AND ASSUMPTIONS

In order to assess the magnitude of water quality impacts to park waters under the various PWC management alternatives, the following methods and assumptions were used:

1. The regulation at 40 CFR 131.12(a)(2) represents an overall goal or principle with regard to PWC use in that the park will strive to fully protect existing water quality so that "fishable / swimmable" uses and other existing or designated uses are maintained. Therefore, PWC use could not be authorized to the degree that it would lower this standard and affect these uses. To do so would potentially violate 40 CFR 131.10, which basically forbids the removal of an existing use (for example, personal watercraft) because the activity was authorized knowing this level of pollution would occur.

2. State water quality standards governing the waters of the park were examined for pollutants whose concentrations in gasoline were available in the literature and for which ecotoxicological and/or human health toxicity benchmarks were available in the literature.

3. Baseline water quality data (if available), especially for pollutants associated with two-stroke engines (PAH, hydrocarbons), were examined. In Colorado, MTBE is not used in gasoline. PWC and other motorized watercraft from other states using MTBE as a gasoline additive may be found at the reservoir; however, according to staff observations, visitors are predominantly from Colorado, with limited out-of-state use, and did not warrant inclusion of MTBE in the analysis.

4. Since no models were available to predict concentrations in water of selected pollutants emitted by personal watercraft and motorboats, an approach was developed to provide estimates of whether PWC (and outboard motor) use over a particular time (for example, over a typical busy weekend day) would result in exceedances of the identified standards, criteria, or toxicity benchmarks. The approach is described in appendix A. Results of this approach were then taken into account, along with site-specific information about currents, mixing, wind, and turbidity, as well as the specific fate and transport characteristics of the pollutant involved (e.g., volatility), to assess the potential for the occurrence of adverse water quality impacts.

5. In general, the approach provides the information needed to calculate emissions to the receiving waterbody from personal watercraft (and, by estimation, from outboard motors) of selected hydrocarbons whose concentrations in the raw gasoline fuel were available in the literature and for which ecotoxicological and/or human health toxicity benchmarks could be acquired from the literature. The selected chemicals were benzene and three PAH (benzo(a) pyrene, naphthalene, and 1-methyl naphthalene). The approach outlined a procedure to first estimate the emissions of these pollutants to the water per operational hour (based on literature values) and to then estimate the total loading of the pollutants into the water, based

on the estimated hours of use. The approach then provided an estimate of how much water would be required to dilute the calculated emission loading to the level of the water quality standard or benchmark. That volume of water (referred to as the "threshold volume of water") was then compared to the total available volume of water.

State of Colorado surface water quality standards for organic chemicals (Regulation No. 31.11) (CDPHE, 2001b) include human health standards for benzo(a)pyrene, naphthalene, and benzene. Organic water quality standards applicable to Blue Mesa Reservoir (applied to all aquatic life class 1 water bodies that also have a water supply classification) are labeled "Water + Fish." Surface water quality standards for these constituents are shown in table 15.

The applicable Colorado organic chemical water quality standards for Curecanti were compared with the respective EPA standards and other benchmarks, and the lower, more restrictive, of the two sets of standards were used. (By complying with the more restrictive benchmarks, both state and federal criteria are satisfied.) Table 16 shows the criteria and benchmarks used to assess water quality impacts. The Colorado, human health based criteria for naphthalene, (Water + Fish) of 28 µg/l was selected; as it is more restrictive than the ecotoxicological benchmark standard (62 µg/l).

6. The principal mechanisms that result in loss of the pollutant from the water were also considered. Many organic pollutants that are initially dissolved in the water volatilize to the atmosphere, especially if they have high vapor pressures, are lighter than water, and mixing occurs at the air/water interface. Other compounds that have low vapor pressure, low solubility, and high octanol/water partition coefficients tend to adhere to organic material and clays and eventually adsorb onto sediments. By considering movements of the organics through the water column, an assessment can be made as to whether there could be an issue with standards or benchmarks being exceeded, even on a short-term basis.

TABLE 15: STATE OF COLORADO WATER QUALITY STANDARDS FOR ORGANIC CHEMICALS

Classification[a]	Benzo(a)pyrene (µg/L)	Naphthalene (µg/L)	Benzene (µg/L)
Water + Fish[b]	0.0044	28	1.2

a. Colorado Standard applied to aquatic life class 1 waters with water supply classification.

b. Human Health based standards.

TABLE 16: ECOTOXICOLOGICAL BENCHMARKS AND HUMAN HEALTH CRITERIA FOR ORGANIC CHEMICALS

Chemical	Ecotoxicological Benchmark (µg/L)	Source	Human Health Criteria[b] (µg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0038	EPA 2003b
Naphthalene	62	Suter and Tsao 1996	28[c]	CDPHE 2001b
1-methyl naphthalene	34[a]	USFWS 2000	—	—
Benzene	130	Suter and Tsao 1996	1.2	CDPHE 2001b

a. Based on LC_{50} of 34 µg/L used for freshwater calculations.

b. Based on the consumption of water and fish.

c. Colorado Water + Fish Standard.

7. The threshold volume of water was calculated in acre-feet (1 acre-foot = 1 acre of water 1 foot deep). For example, if results showed that for benzo(a)pyrene, 55 acre-feet of water would be needed to dilute the expected emissions to below the benchmark level, and the receiving body of water is a 100-acre reservoir with an average depth of 20 feet (= 2000 acre-feet) and is well-mixed, then this would indicate little chance of a problem, especially when adding the effects of any other processes that contribute to the loss of benzo(a)pyrene from the water column. However, if the impact area is a 5-acre backwater averaging 2 feet deep (10 acre-feet), then there may be at least a short-term issue, especially if outboard emissions are added or there is little mixing in the area.

8. To assess cumulative impacts, emissions from other motorized boats were also determined, based on estimates of relative emissions of unburned fuel and hours of use. Emissions from two-stroke, carbureted outboard engines and inboard or inboard/outboard engines at the park were then added to PWC emissions to yield a more complete estimation of loading to the receiving water body. Several studies have demonstrated that four-stroke engines are substantially cleaner than carbureted two-stroke engines, generating approximately 90% fewer emissions (NALMS 1999). Oregon Department of Environmental Quality estimates emissions from four-stroke and direct-injection two-stroke engines to be from 75% to 95% cleaner (ODEQ 1999). A distinction is made in the water quality analysis in order to differentiate between the two-stroke, carbureted outboard engines and the cleaner four-stroke, or two-stroke direct injection engines (inboard or inboard/outboard engines). The total emissions calculated from the numbers of inboard or inboard/outboard engines will be reduced by 90%. The estimates used for relative loading from various engine types are obtained from available data.

9. Reductions in emissions from personal watercraft and outboards are outlined by the U.S. Environmental Protection Agency over the next 10 years (see table 17).

   Key dates in this chronology begin with 1999, when the U.S. Environmental Protection Agency began to require production line testing for 75% HC reduction in new outboard motors, and 2000, when testing for 75% HC reduction in personal watercraft was started. By 2006 all new personal watercraft and outboards manufactured in the United States must have a 75% reduction in HC emissions. In 2005 and 2012 overall reductions in HC emissions are estimated to be 25% and 50%, respectively, in PWC and outboard motors. These estimates are based on estimates of the emissions reduction percentages and associated years reported by the U.S. Environmental Protection Agency (1996a), but with a one-year delay in the implementation of production line testing (EPA 1997). The 52% reduction estimated for 2012 was used in the calculations for alternatives A, B and no-action in this assessment.

TABLE 17: ESTIMATED EPA REDUCTIONS IN WATERCRAFT EMISSIONS

Date	Action
1999	EPA requires production line testing for 75% HC reduction in new outboards and begins to see reductions as newer models are introduced (EPA 1997).
2000	EPA requires production line testing for 75% HC reduction in new personal watercraft and begins to see reductions as newer models are introduced (EPA 1997).
2005	Estimated 25% reduction in HC emissions overall as a result of newer models being gradually used (EPA 1996a; date modified in EPA 1997).
2006	EPA fully implements production line testing for 75% HC reduction in new outboards and personal watercraft (EPA 1996a).
2012	Estimated 52% reduction in HC emissions overall (EPA 1996a; date modified in EPA 1997).

10. To evaluate water quality impacts at Curecanti, water volumes and water quality calculations were analyzed for the mixing zone defined for Blue Mesa Reservoir. This mixing zone was assumed as the volume of water between the minimum pool elevation (7,393 feet) and the top of the thermocline (located on average approximately 21 feet below the minimum pool elevation assuming a constant thermal regime at all reservoir locations). Within this mixing zone, waters freely mix. To give the most conservative estimate, the available volume of water available for mixing at minimum pool is 52,433 acre-feet. Additional information on the derivation of this estimate is found in the "Affected Environment" chapter.

11. PWC and motorboat numbers are provided at the beginning of this chapter in the "PWC and Boating Use Trends" section. PWC and boating use for the entire reservoir reflecting peak use days (Fourth of July and Labor Day) were used for the assessment of impacts to water quality. These estimates were based on Park staff observations in 2001 and 2002 as well as Colorado Division of Wildlife creel surveys (NPS 2002c). Estimation of the total motorized vessels (personal watercraft and other motorized boats) per day for the peak use days for 2002 was 216 (refer to table 11). Of that total, the number of PWC is estimated to be approximately 16 two-stroke carbureted engines (7% of the total motorized vessels). The total number of other motorboats estimated to operate at the reservoir during peak use days was approximately 200. Of the 200 motorboats, 133 are assumed to be two-stroke, carbureted outboard engines (fishing type boats) and 67 are assumed to be inboard or inboard/outboard engines based on the park boating registration survey (NPS 2000d) and park staff observation.

    Annual increases in boating (not including personal watercraft) of 1.75% from 2002 to 2005 were assumed. The annual increase in boating was assumed to decrease to 1.66% from 2005 to 2015. Annual increases in PWC use was assumed to be 2% for the entire 2002 to 2015 period. Using these assumptions, an estimation of the total motorized vessels per day for the peak use days for 2012 was 256. Of that total, the number of PWC are estimated to be approximately 20 (7% of the total motorized vessels). The total number of other motorboats estimated to operate at the reservior during peak use days was approximately 236. Of the 236 motorboats, 157 are assumed to be two-stroke, carbureted outboard engines and 79 are assumed to be inboard or inboard/outboard engines.

    The following describes how PWC and motorboat operations were evaluated to determine potential water quality impacts at Curecanti:

    - The majority of motorboats operating within the Blue Mesa Reservoir are assumed to have two-stroke, carbureted outboard engines. All motorboats are assumed to have engines larger than 15 horsepower. Inboard and inboard/outboard motorboats are included in the analysis, assuming a 90% reduction of the resulting emissions.

    - According to Park personnel, the boating day is limited by environmental factors. Typically, PWC arrive around 10:00 am, and leave by 1:00 pm to 2:00 pm because of strong afternoon winds. This summer weather pattern is fairly consistent. Most PWC use involves cycling riders on and off the vessel, so they are heavily used at full throttle for approximately 2 hours. Fishing boats (predominantly two-stroke, carbureted engines) tend to stay out longer, but are not operating at full throttle for much of the time (NPS 2002c). It was assumed that boats would discharge gasoline and its constituents at ¼ of the rate expected at full throttle. The effective time at full throttle used in the analysis was estimated as 2 hours for two-stroke, carbureted engines.

- When released to water, benzene is subject to rapid volatilization, with a half-life for evaporation of about 5 hours (EPA 2001). The loss of benzene from the water column is discussed qualitatively where applicable.

- Some research shows that PAH, including those from personal watercraft emissions, adversely affect water quality via harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). In the clear, shallow arm areas of Blue Mesa Reservoir heavy concentration of PWC and other motorboat activity could lead to an increase in photoxic effects from PAH in lake sediments. Monitoring of these areas could be considered to determine if phototoxic effects from PAH's may be of concern.

IMPACT ANALYSIS AREA

The impact analysis area for water quality includes Blue Mesa Reservoir within the administrative boundary of Curecanti National Recreation Area. The impact analysis area does not include Morrow Point, or Crystal Reservoirs, which are closed to PWC use due to a horsepower restriction.

IMPACT TO WATER QUALITY FROM PWC USE

Given the above water quality issues and methodology and assumptions, the following impact thresholds were established in order to describe the relative changes in water quality (both overall, localized, short and long term, cumulatively, adverse and beneficial) under the various personal watercraft management alternatives.

Negligible: Impacts are chemical, physical, or biological effects that would not be detectable, would be well below water quality standards or criteria, and would be within historical or desired water quality conditions.

Minor: Impacts (chemical, physical, or biological effects) would be detectable but would be well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Impacts (chemical, physical, or biological effects) would be detectable but would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions would be altered on a short-term basis.

Major: Impacts (chemical, physical, or biological effects) would be detectable and would be frequently altered from the historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards or criteria would be slightly and singularly exceeded on a short-term basis.

Impairment: Impacts are chemical, physical, or biological effects that would be detectable and that would be substantially and frequently altered from the historical baseline or desired water quality conditions and/or water quality standards, or criteria would be exceeded several times on a short-term and temporary basis. In addition, these adverse, major impacts to park resources and values would:

- Contribute to deterioration of the park's water quality and aquatic resources to the extent that the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement;
- Affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- Affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC use would be reinstated within Curecanti in all locations of the recreation area where it was allowed until November 6, 2002. All designated launch areas of Blue Mesa Reservoir would remain open to PWC use. PWC would be allowed to land on any shoreline.

Numbers of personal watercraft using the reservoir during a high-use day are estimated to be 16 in 2002 with an increase to 20 in 2012, an average increase of 2.0% per year. In 2012, the emissions calculated reflect a 52% reduction applied in order to incorporate EPA estimates of engine conversion based on the 1996 EPA regulations (EPA 1996a). Two hours of use per day was used in the calculation of pollutant loading to the reservoir.

An estimate of how much water would be required to dilute the calculated emission loading from PWC to the level of the water quality standard or benchmark is shown in the table 18. That volume of water (referred to as the "threshold volume of water") was then compared to the total available volume of water in the mixing zone at minimum pool level of Blue Mesa Reservoir (52,433 acre-feet).

TABLE 18: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVES A AND B

	Water Volumes Needed for Dilution (acre-feet)	
	2002	2012
Volume of water available in mixing zone at minimum pool	52,433	
Ecotoxicological Benchmarks[a]		
Benzo(a)pyrene (fuel and exhaust)	44	28
Naphthalene	18	11
1-methyl naphthalene	50	31
Benzene	42	26
MTBE	N/A	N/A
Human Health Benchmarks[b]		
Benzo(a)pyrene (fuel and exhaust)	163	102
Benzene	4,534	2,833
MTBE	N/A	N/A
Colorado Water + Fish (based on Human Health Benchmarks)[c]		
Naphthalene	39	24

N/A = MTBE not used in gasoline sold in Colorado; see "Affected Environment" chapter, "Methodology" section, and appendix A.

a. Threshold volume (in acre-feet) below which ecotoxicological effects might occur.

b. Threshold volumes (in acre-feet) below which human health might be impacted.

c. Colorado standard for naphthalene (28 µg/l) is more restrictive than the ecotoxicological benchmark.

The 2002 and 2012 threshold volumes to meet ecotoxicological benchmarks range from 11 to 50 acre-feet, respectively. These volumes are extremely small in relation to the volumes of water available (52,433 acre-feet in available mixing zone of Blue Mesa Reservoir at minimum pool), indicating that these pollutant loads would result in concentrations well below the ecotoxicological benchmarks. Consequently, negligible adverse impacts are expected in 2002 and in 2012.

Theshold volumes required to meet human health benchmarks (including Colorado's human health based standard for naphthalene) were also well below the volume available at Blue Mesa Reservoir. In 2002 and 2012 the threshold volume required to meet these human health benchmarks would range from 24 to 4,534 acre-feet, respectively, resulting in negligible adverse impacts.

The most limiting estimated threshold water volume required to meet human health benchmarks is for benzene. The threshold volumes required to meet the benzene human health benchmark are 4,534, and 2,833 acre-feet, for 2002 and 2012, respectively. For benzene, factors other than those discussed above that affect surface water concentrations (especially volatilization) also are considered, but were not incorporated into the estimate of threshold volume. The half-life of benzene in water is less than 5 hours at summer water temperatures near 30°C (Verschuren 1983; EPA 2001). In other words, half the benzene in water would evaporate in less than 5 hours.

Overall, pollutant loads in 2012 would be lower than in 2002 because PWC use would only increase from 16 to 20 on a peak day and because of the 52% reduction in PWC and outboard motorboat engine emissions estimated by the EPA (1997).

Cumulative Impacts. In addition to the personal watercraft that use Blue Mesa Reservoir, other two-stroke outboard motorboats, and to a lesser degree the inboard or inboard/outboard motorboats would contribute pollutants to the water. A total of 216 vessels in 2002 and 256 vessels in 2012 are estimated during a peak use day. Table 19 shows how these vessels are distributed for the analysis of cumulative impacts.

Emissions were calculated for each vessel type for both 2002 and 2012. Emissions from inboard or inboard/outboard engines were assumed to be 10% of emissions calculated for two-stroke outboard engines or for PWC (assuming all PWC's have two-stroke, carbureted engines). These emissions were summed. In 2012, the emissions calculated reflect a 52% reduction applied in order to incorporate EPA estimates of engine conversion based on the 1996 EPA regulations (EPA 1996a). Two hours of use per day was used in the calculation pollutant loading to the reservoir (table 20).

TABLE 19: DISTRIBUTION OF VESSEL TYPE DURING PEAK USE DAYS

Vessel Type	Number of Vessels	
	2002	2012
Carbureted two-stroke, outboard engines	133	157
Inboard or Inboard/Outboard engines	67	79
PWC, two-stroke, carbureted engine	16	20
Total Vessels	**216**	**256**

TABLE 20: THRESHOLD WATER VOLUMES NEEDED TO DILUTE ALL VESSEL EMISSIONS, ALTERNATIVES A AND B

	Water Volumes Needed for Dilution (acre-feet)	
	2002	2012
Volume of water available in mixing zone at minimum pool	52,433	
Ecotoxicological Benchmarks[a]		
Benzo(a)pyrene (fuel and exhaust)	595	460
Naphthalene	171	106
1-methyl naphthalene	485	300
Benzene	407	252
MTBE	NA/	N/A
Human Health Benchmarks[b]		
Benzo(a)pyrene (fuel and exhaust)	1,588	983
Benzene	44,117	27,315
MTBE	N/A	N/A
Colorado Water + Fish (based on Human Health Benchmarks)[c]		
Naphthalene	378	234

NA = MTBE not used in gasoline sold in Colorado; see "Affected Environment" chapter, "Methodology" section, and appendix A.

a. Threshold volume (in acre-feet) below which ecotoxicological effects might occur.

b. Threshold volumes (in acre-feet) below which human health might be impacted.

c. Colorado standard for naphthalene (28 µg/l) is more restrictive than the ecotoxicological benchmark.

The calculated threshold volumes for pollutants emitted in 2002 by personal watercraft and other motorboats are approximately an order of magnitude greater than the threshold volumes due to personal watercraft alone. The cumulative threshold volumes based on ecotoxicological benchmarks would range from 171 to 595 acre-feet in 2002. Effects would be long-term because they would recur during each summer heavy-use season. In 2012, ecotoxicological threshold volumes would decrease to a range of 106 to 460 acre-feet, despite an estimated 1.5% to 2% annual increase in the numbers of personal watercraft and other motorboats, because of the reduction of emissions expected from the 1996 EPA rule. Concentrations of all the organic contaminants evaluated are well below the water quality benchmarks and would likely not be detectable. Cumulative ecotoxicological impacts would be negligible adverse in both 2002 and 2012.

Based on the human health benchmarks, the calculated threshold volumes for benzo(a)pyrene emitted by personal watercraft and boats in 2002 and 2012 would be 1,588 and 983 acre-feet, respectively. The calculated threshold volume for naphthalene (Colorado standard) for 2002 and 2012 would be 378 and 234 acre-feet, respectively. The benzo(a)pyrene and naphthalene threshold volumes would be substantially lower than the available water volumes in Blue Mesa Reservoir, and therefore, would result in negligible adverse impacts to human health.

Threshold volumes for benzene on a high-use day in 2002 and 2012 are 44,117 and 27,315 acre-feet, respectively. These required threshold volumes would result in minor to moderate adverse impacts relative to water volumes needed to dilute all other vessel emissions (see table 20). Based on a 5-hour half-life for benzene in water, the concentration of benzene would result in minor adverse impacts in less than 5 hours.

Threshold volumes for benzene in 2012 would be lower than in 2002 because of the 52% reduction in PWC and outboard motorboat engine emissions estimated by the EPA (1997).

Conclusion. Alternative A would have negligible adverse effects on water quality based on ecotoxicological threshold volumes. All pollutant loads in 2002 and 2012 from personal watercraft and other motorboats would be well below ecotoxicological benchmarks and criteria.

Water quality impacts from PWC from benzo(a)pyrene, naphthalene and benzene based on human health (ingestion of water and fish) benchmarks, and EPA and state of Colorado water quality criteria, would range from negligible to minor adverse in both 2002 and 2012. Cumulative impacts from personal watercraft and other motorboats would be negligible adverse for benzo(a)pyrene and naphthalene. Cumulative water quality impacts due to benzene would be minor to moderate adverse in 2002 and 2012 based on human health benchmarks. Impacts in Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered.

Implementation of this alternative would not result in an impairment of water quality.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. As under alternative A, PWC use would be reinstated within Curecanti in all locations of the recreation area where it was allowed until November 6, 2002. A 100-foot buffer zone along the south shore of the main body stretching from Iola to Middle Bridge, and a second buffer zone along the north shore at Stevens Creek, would not change impacts on water quality from alternative A. The buffer zone along the south shore was added to prevent erosion among other reasons. The buffer zone along the north shore is for the protection of the Gunnison sage grouse. Numbers of vessels in 2002 and 2012 would remain the same, and there would be no restrictions for PWC use anywhere within the reservoir except within the buffer zones. Thus, results of analysis and direct, indirect, and cumulative impacts, are the same as under alternative A (refer to tables 18 and 20).

Cumulative Impacts. Cumulative emissions in Blue Mesa Reservoir would be similar to alternative A. In addition to the personal watercraft that use Blue Mesa Reservoir, other two-stroke outboard motorboats, and to a lesser degree the inboard or inboard/outboard motorboats would contribute pollutants to the water. A total of 216 vessels in 2002 and 256 vessels in 2012 are estimated during a peak use day. Table 19 shows how these vessels are distributed for the analysis of cumulative impacts.

Conclusion. The impacts of alternative B would be the same as alternative A. Alternative B would have negligible adverse effects on water quality based on ecotoxicological threshold volumes. All pollutant loads in 2002 and 2012 from personal watercraft and other motorboats would be well below ecotoxicological benchmarks and criteria.

Water quality impacts from PWC from benzo(a)pyrene, naphthalene and benzene based on human health (ingestion of water and fish) benchmarks and EPA and state of Colorado water quality criteria, would range from negligible to minor adverse in both 2002 and 2012. Cumulative impacts from personal watercraft and other motorboats would be negligible adverse for benzo(a)pyrene and naphthalene. Cumulative water quality impacts due to benzene would be minor to moderate adverse in 2002 and 2012 based on human health benchmarks. Impacts in Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered.

Implementation of this alternative would not result in an impairment of water quality.

Impacts of No-action Alternative: No PWC Use Allowed

Analysis. No PWC use would be allowed within Curecanti jurisdictional waters after November 6, 2002. Therefore, for the purpose of assessing impacts to water quality, it is assumed that personal watercraft would not contribute pollutants to the waters of Blue Mesa Reservoir. The no-action alternative would have a beneficial impact on water quality at Curecanti in proportion to the relative numbers of personal watercraft and other motorboats.

Cumulative Impacts. Cumulative emissions in Blue Mesa Reservoir would be less than under alternative A or B because of the elimination of PWC use. Despite the elimination of PWC use, activity by other motorboats on an average high-use day would be the same as described under the previous alternatives, increasing from an estimated 200 boats in 2002, to 236 boats in 2012 (table 21).

Threshold volumes in both areas in 2002 and 2012 based on ecotoxicological benchmarks for pollutants and on the human health benchmark for benzo(a)pyrene and naphthalene are all substantially lower than the water volumes available. Therefore, emissions from motorboats other than personal watercraft (i.e., cumulative impacts) would have a negligible adverse impact on water quality.

Despite the absence of personal watercraft, impacts due to benzene from other motorboats would continue. The estimated threshold volumes, based on EPA water quality criteria, are 39,584 and 24,481 acre-feet in 2002 and 2012, respectively, and impacts are expected to be moderate adverse and minor adverse, respectively. After considering the affects of the half-life of benzene the adverse impacts are reduced to minor adverse and negligible adverse in 2002 and 2012, respectively.

TABLE 21: THRESHOLD WATER VOLUMES NEEDED TO DILUTE ALL VESSEL EMISSIONS, NO-ACTION ALTERNATIVE

	Water Volumes Needed for Dilution (acre-feet)	
	2002	2012
Volume of water available in mixing zone at minimum pool	52,433	
Ecotoxicological Benchmarks[a]		
Benzo(a)pyrene (fuel and exhaust)	550	432
Naphthalene	153	95
1-methyl naphthalene	435	269
Benzene	365	226
MTBE	N/A	N/A
Human Health Benchmarks[b]		
Benzo(a)pyrene (fuel and exhaust)	1,424	881
Benzene	39,584	24,481
MTBE	N/A	N/A
Colorado Water + Fish (based on Human Health Benchmarks)[c]		
Naphthalene	339	210

NA: MTBE not used in gasoline sold in Colorado; see "Affected Environment" chapter, "Methodology" section, and appendix A.

a. Threshold volume (in acre-feet) below which ecotoxicological effects might occur.

b. Threshold volumes (in acre-feet) below which human health might be impacted. c. Colorado standard for naphthalene (28 µg/l) is more restrictive than the ecotoxicological benchmark.

Conclusion. The no-action alternative would have a beneficial impact on water quality. Pollutant loads from personal watercraft would be eliminated. Cumulative impacts from the remaining motorboats would be negligible adverse for all ecotoxicological benchmarks and for the human health benzo(a)pyrene and naphthalene benchmarks. Impacts based on the potential effects of benzene on human health range from minor to moderate adverse in 2002 to 2012. Impacts to Blue Mesa Reservoir due to benzene would be reduced to minor adverse impacts when the half-life of benzene is considered.

Implementation of this alternative would not result in an impairment of water quality.

AIR QUALITY

Personal watercraft emit various compounds that pollute the air. In the two-stroke engines commonly used in personal watercraft; the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as volatile organic compounds (VOC), nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO). Personal watercraft also emit fuel components such as benzene that are known to cause adverse health effects. Even though PWC engine exhaust is usually routed below the waterline, a portion of the exhaust gases go into the air. These air pollutants may adversely impact park visitor and employee health, as well as sensitive park resources. For example, in the presence of sunlight VOC and NO_x emissions combine to form ozone. Ozone causes respiratory problems in humans, including cough, airway irritation, and chest pain during inhalations (EPA 1996c). Ozone is also toxic to sensitive species of vegetation. It causes visible foliar injury, decreases plant growth, and increases plant susceptibility to insects and disease (EPA 1996c). Carbon monoxide can affect humans as well. It interferes with the oxygen carrying capacity of blood, resulting in lack of oxygen to tissues. NO_x and PM emissions associated with PWC use can also degrade visibility (California Air Resources Board 1997; EPA 2000a). NO_x can also contribute to acid deposition effects on plants, water, and soil. However, because emission estimates show that NO_x from personal watercraft are minimal (less than 5 tons per year), acid deposition effects attributable to personal watercraft use are expected to be minimal.

GUIDING REGULATIONS AND POLICIES

Clean Air Act. The *Clean Air Act* established national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The act also established the prevention of significant deterioration (PSD) of air quality program to protect the air in relatively clean areas. One purpose of this program is to preserve, protect, and enhance air quality in areas of special national or regional natural, recreational, scenic, or historic value (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

- Class I areas are afforded the greatest degree of air quality protection. Very little deterioration of air quality is allowed in these areas, and the unit manager has an affirmative responsibility to protect visibility and all other class I area air quality related values from the adverse effects of air pollution.

- Class II areas include all national park system areas not designated as class I, and the *Clean Air Act* allows only moderate air quality deterioration in these areas. In no case, however, may pollution concentrations violate any of the national ambient air quality standards. Curecanti National Recreation Area is designated a class II area.

Conformity Requirements. National park system areas that do not meet the national ambient air quality standards or whose resources are already being adversely affected by current ambient levels require a greater degree of consideration and scrutiny by NPS managers. Areas that do not meet national air quality standards for any pollutant are designated as nonattainment areas. Section 176 of the *Clean Air Act* states:

> No department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve, any activity that does not conform to an implementation plan [of the State]. . . . [T]he assurance of conformity to such a plan shall be an affirmative responsibility of the head of such department, agency or instrumentality.

Essentially, federal agencies must ensure that any action taken does not interfere with a state's plan to attain and maintain the national ambient air quality standards in designated nonattainment and maintenance areas. In making decisions regarding PWC use within a designated nonattainment or maintenance area, park managers should discuss their plans with the appropriate state air pollution control agency to determine the applicability of conformity requirements. Curecanti National Recreation Area is an attainment area for all pollutants, so the conformity requirements do not apply to this unit.

Applicable PWC Emission Standards. The Environmental Protection Agency issued the gasoline marine engine final rule in August 1996. The rule, which took effect in 1998, affects manufacturers of new outboard engines and the type of inboard engines used in personal watercraft. The agency adopted a phased approach to reduce emissions. The current emission standards were set at levels that are achievable by existing personal watercraft. By 2006 PWC manufacturers will be required to meet a corporate average emission standard that is equivalent to a 75% reduction in HC emissions. (The corporate average standard allows manufacturers to build some engines to emission levels lower than the standard and some engines to emission levels higher than the standard, and to employ a mix of technology types, as long as the overall corporate average is at or below the standard.) Because the actual reduction in emissions is dependent on the sale of lower-emitting personal watercraft, the Environmental Protection Agency estimated that a 52% emission reduction in the national outboard/PWC HC inventory will be achieved by 2010, and a 75% emission reduction by 2030.

In July 2002, the Environmental Protection Agency proposed new evaporative emissions standards for gasoline-fueled boats and personal watercraft. These proposed standards would require most new boats produced in 2008 or later to be equipped with low-emission fuel tanks or other evaporative emission controls.

NPS Organic Act and Management Policies. The NPS *Organic Act of 1916* (16 USC 1, et seq.) and the NPS *Management Policies* guide the protection of park and wilderness areas. The general mandates of the *Organic Act* state that the National Park Service will:

> promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks, . . . which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1).

Under its *Management Policies 2001* the National Park Service will:

> seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (sec. 4.7.1).

The *Management Policies* further state that the National Park Service will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the National Park Service "will err on the side of protecting air quality and related values for future generations."

The *Organic Act* and the *Management Policies* apply equally to all areas of the national park system, regardless of *Clean Air Act* designations. Therefore, the National Park Service will protect resources at both class I and class II designated units. Furthermore, the NPS *Organic Act* and *Management Policies* provide additional protection beyond that afforded by the *Clean Air Act's* national ambient air quality standards alone because the National Park Service has documented that specific park air quality related values can be adversely affected at levels below the national standards or by pollutants for which no standard exists.

METHODOLOGY AND ASSUMPTIONS

In order to assess the level of PWC air quality impacts resulting from a given management alternative, the following methods and assumptions were used:

1. The national ambient air quality standards and state/local air quality standards (if applicable) were examined for each pollutant.

2. Air quality designations for the surrounding area were determined. Curecanti National Recreation Area is in an attainment area for each pollutant.

3. There is no monitoring location near the Curecanti National Recreation Area that provides representative ambient data. Based on data from the Colorado Air Quality control Commission, as described in the "Affected Environment" chapter, all highest maximum concentrations for each pollutant are below the national ambient air quality standards.

4. Typical use patterns of motorized watercraft were identified (see "PWC and Boating Use Trends" section).

5. The rated horsepower, average engine load, and other relevant parameters for each watercraft type were taken from default assumptions in the EPA NONROAD model. This model is used to calculate emissions of criteria pollutants from the operation of nonroad spark-ignition type engines, including personal watercraft. The model allows assumptions to be made regarding the mix of engine types that will be converted as new engine standards come into effect, and increasing numbers of personal watercraft will be of the cleaner-burning four-stroke type.

6. Hydrocarbon emissions from internal combustion are characterized in various references and regulations as total hydrocarbons (THC), hydrocarbons (HC), volatile organic compounds (VOC), and reactive organic gases (ROG), as well as other terms. While there are technical differences among some of these terms, the quantitative differences are negligible for purposes of this environmental analysis. The remainder of this discussion describes all

hydrocarbon emissions as HC, which is the term used in the EPA regulation for control of emissions from marine engines.

7. PAH are released during the combustion of fuel, though some PAH are also found in unburned gasoline. Kado et al. 2000 indicated that changing from two-stroke carbureted engines to two-stroke direct-injection engines may result in increases of airborne particulate-associated PAH. The same study indicated that four-stroke engines have considerably less PAH emissions than two-stroke engines[4]. A subsequent study of airborne emissions indicated a potential health risk from toxic pollutants in areas of high concentration of exhaust from many engines, such as in an engine maintenance shop (Kado, Kuzmicky, and Okamoto 2001).

8. Any reductions in emissions resulting from implementing control strategies were taken into account, as were changes in emissions resulting from increased or decreased usage.

9. Studies regarding ozone injury on sensitive plants found in the recreational area were requested, but none were available for Curecanti.

10. A calculation referred to as SUM06 (ppm-hours) was used for assessing regional ozone exposure levels. These data are collected from rural and urban monitoring sites. The highest three-month, five-year average commonly used for the area was determined by reviewing ambient air quality data (available from the NPS Air Resources Division).

11. Visibility impairment was determined from local monitoring data, or from qualitative evidence such as personal observations and photographs.

12. The air quality impacts of the various alternatives were assessed by considering the existing air quality levels and the air quality related values present, and by using the estimated emissions and any applicable, EPA-approved air quality models. Estimated reductions in hydrocarbon emissions would be the same as those described for water quality.

13. For cumulative impacts, the assessment was completed quantitatively with respect to anticipated use of the recreational area by other recreational watercraft based on emission factors and assumption in EPA's nonroad model. Types of craft assessed for quantitative cumulative impacts included outboard spark-ignition type engines and PWC. Other sources of air pollutants in the area were also considered in the cumulative analysis through a review of the state implementation plan, county records, and the use of best professional judgment.

14. Pollutant emissions were calculated for 2002 and 2012. As described in the "Water Quality" section, estimates of watercraft use were based on data park staff observations and Colorado Division of Wildlife data. For 2002, it was assumed that there were 14,618 combined PWC and boat trips, as shown previously in table 11. PWC use was assumed at 792 machines, each of which was assumed to engage in one trip, two hours in duration. The non-PWC trips were assumed to be 13,826 total: 9,914 outboard engines boats (66.5%) and 4,632 inboard engines (33.5%). For 2002, it was assumed that all PWC and outboard engines at Curecanti were carbureted two-stroke (dirty) engines, and that all inboard engines were four-stroke (clean) engines. PWC activity would increase 2% annually and boating activity would increase 1.66 to 1.75% annually at Curecanti between 2002 and 2012.

4. It is noted that only one engine of each type, two-stroke carbureted, two-stroke direct injection, and four-stroke, was tested.

Between 2002 and 2012, some carbureted two-stroke PWC and outboards would be replaced with watercraft with the cleaner direct injection two-stroke, electric fuel injection two-stroke, or four-stroke engines. This replacement would occur as a result of the EPA requirement for manufacturers to supply the cleaner engines. Consistent with EPA forecasts, it was assumed that the introduction of cleaner engines would result in a 52% reduction of HC emissions for each engine type by 2012.

PWC impact thresholds for air quality are dependent on the type of pollutants produced, the background air quality, and the pollution-sensitive resources (air quality related values) present. Impact thresholds may be qualitative (e.g., photos of degraded visibility) or quantitative (e.g., based on impacts to air quality related values or federal air quality standards, or emissions based), depending on what type of information is appropriate or available.

Two categories for potential airborne pollution impacts from personal watercraft were analyzed: impacts on human health resources, and impacts on air quality related values in the impact analysis area. Thresholds for each impact category (negligible, minor, moderate, and major) are discussed for each impact topic.

IMPACT ANALYSIS AREA

The impact analysis area includes the immediate location of PWC use and the surrounding national recreation area where air pollutants may accumulate. More specifically, the impact analysis area is Blue Mesa Reservoir plus a 100-foot-wide strip inland. It is assumed that air pollutants would dissipate beyond 100 feet due to air currents.

IMPACT TO HUMAN HEALTH FROM AIRBORNE POLLUTANTS RELATED TO PWC USE

The following impact thresholds for an attainment area have been defined for analyzing impacts to human health from airborne pollutants — CO, PM_{10}, hydrocarbon (HC), and NO_x. Sulfur oxides (SO_x) are not included because they are emitted by personal watercraft in very small quantities.

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Moderate:	Emissions would be greater than or equal to 100 tons/year for any pollutant.	**or**	The first highest three-year maximum for each pollutant is greater than NAAQS.
Major:	Emissions levels would be greater than or equal to 250 tons/year for any pollutant.	**and**	The first highest three-year maximum for each pollutant is greater than NAAQS.

Impairment — Impacts would:

- Have a major adverse effect on park resources and values; or
- Contribute to deterioration of the park's air quality to the extent the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement; or
- Affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- Affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Both HC and NO_x are ozone precursors in the presence of sunlight and are evaluated separately in lieu of ozone, which is formed as a secondary pollutant. (Note that in attainment areas the *Clean Air Act* does not require that NO_x be counted as an ozone precursor).

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. Under this alternative, the use of Curecanti by PWC would be reinstated and managed under the management strategies that were in place until November 6, 2002, when the park was closed to PWC use. Based on data provided in the "PWC and Boating Use Trends" section, PWC annual use is estimated to be 792 PWC in 2002, increasing at approximately 2% annually to 965 PWC in 2012.

The impacts of continued PWC use are presented in table 22. Adverse impacts related to PWC use in 2002 would be negligible for CO, HC, PM_{10} and NO_x for 2002 and 2012. In 2012, human-health-related air quality impacts would reflect the predicted 2% annual increase in PWC activity and reflect approximately 50% improvement in engine HC emission rates compared to 1998. This improvement would result from cleaner-burning PWC engines required by the EPA. As a result, air quality impacts in 2012 would be negligible. Reductions in emissions of all pollutants would occur, except for NO_x, which is predicted to increase by a very small amount. This increase would occur because the design in two-stroke direct-injection and four-stroke engines required to achieve substantial HC reductions results in slightly higher NO_x emissions.

The human health risk from PAH would be negligible in 2002 and 2012 because personal watercraft do not congregate in areas at Curecanti where exhaust would concentrate. Further, as engines are converted from two-stroke to four-stroke, the emissions of PAH will decrease, thereby reducing the health risk.

Cumulative Impacts. Other motorized watercraft are assessed quantitatively in combination with PWC, taking into consideration regional and local air pollution sources. As described under " Methodology" in the "Air Quality" section, boats account for approximately 95% of the annual motorized watercraft activity at Curecanti. NPS data and CDOW creel surveys indicate non-PWC use at an estimated 13,826 boats per year in 2002, increasing to 16,344 boats per year in 2012. The combined emissions from PWC and other boats are provided in table 23. Overall, cumulative impact levels for $PM_{10,}$ HC, and NO_x would be negligible adverse, while the impact levels for CO would be minor adverse.

Combined emissions of CO would increase from 2002 to 2012. This would occur because two types of cleaner (i.e., reduced HC) outboard engines – fuel injection two-stroke and four-stroke – have higher CO emissions than the carbureted two-stroke engines. As boating increases annually and two-stroke engines are replaced with these cleaner engines, CO emissions would also increase. Although monitoring data are

TABLE 22: PWC EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM_{10}		HC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	9.4	9.1	0.2	0.2	4.7	2.9	<0.1	0.1
Impact Level	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

TABLE 23: PWC AND MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVES A AND B

	CO		PM_{10}		HC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	79.6	99.8	1.7	1.5	29.0	18.0	0.8	1.7
Impact Level	Minor	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

not available for CO in the area of Curecanti, ambient CO levels are assumed to be below NAAQS within this area, based on data from the Colorado Air Quality Control Commission and reportedly low traffic congestion. High local CO levels usually occur in areas of severe traffic congestion, which is not the situation at Curecanti. Emission rates of HC would be reduced by approximately 38% between 2002 and 2012 as a result of technological improvements in marine engines, even with an estimated 18% increase in motorized boating activity at Curecanti. Additional cumulative emissions reductions are likely as the EPA implements regulations targeted at improving motorized watercraft engine performance. PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012.

Conclusion. Alternative A would result in negligible adverse impacts for CO, HC, PM_{10} and NO_x in 2002 and 2012. The human health risk from PAH would also be negligible.

Cumulative emissions would be negligible adverse for PM_{10}, HC, and NO_x, and minor adverse for CO in 2002 and 2012. CO emissions would increase from 2002 to 2012 because of increased boating activity and cleaner engines that have higher CO emissions. This alternative would maintain existing air quality conditions, with future reductions in PM_{10} and HC emissions due to improved emission controls. Overall, PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012.

Implementation of this alternative would not result in an impairment of air quality.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Under this alternative, personal watercraft would be reinstated with some locational restrictions or speed restrictions in addition to the management strategies in force until November 6, 2002. The additional restrictions would not change the type of PWC in use nor increase or decrease the number of PWC forecasted or their daily duration of use between 2002 and 2012. Thus, the direct, indirect, and cumulative human-health air quality impacts of alternative B would be the same as alternative A.

Cumulative Impacts. Cumulative impacts of alternative B would be the same as alternative A, as noted in table 23.

Cumulative impact levels, for $PM_{10,}$ HC, and NO_x would be negligible, while the impact levels for CO would be minor. Combined emissions of CO would increase from 2002 to 2012. As noted in alternative A, this would occur because two types of cleaner engines, electric fuel injection two-stroke and four-stroke, have higher CO emissions than the carbureted two-stroke engines. Emission rates of HC would be reduced by approximately 38% between 2002 and 2012 as a result of technological improvements, even with an estimated 18% increase in motorized boating activity. Additional cumulative emissions reductions are likely as the U.S. Environmental Protection Agency implements regulations targeted at improving motorized watercraft engine performance. PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012.

Conclusion. Alternative B would result in the same impacts as alternative A. Additional management prescriptions would not noticeably affect PWC emissions. As in alternative A, negligible adverse impacts for CO, HC, PM_{10} and NO_x would occur in 2002 and 2012. The risk from PAH would also be negligible.

Cumulative emission levels would be minor adverse for CO and negligible adverse for PM_{10}, HC, and NO_x. This alternative would maintain existing air quality conditions, with future reductions in PM_{10} and HC emissions due to improved emission controls. PWC emissions of HC are estimated to be approximately 16% of the cumulative boating emissions in 2002 and 2012.

Implementation of this alternative would not result in an impairment of air quality.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Under the no-action alternative PWC use would be banned, eliminating PWC emissions of CO, PM_{10}, HC, and NO_x within the recreation area boundary, and resulting in long-term beneficial impacts.

Cumulative Impacts. As described for alternative A, motorized boats are a primary source of air pollutants within the national recreation area and would continue to emit pollutants. PWC contribution to overall cumulative emissions would be eliminated. Cumulative emissions for all other watercraft would range from negligible adverse for PM_{10}, HC, and NO_x, and minor adverse for CO (see table 24), and would be less than emissions calculated for the other alternatives due to the elimination of PWC use. HC emissions in 2012 would be less than in 2002 because of the continuing introduction of cleaner engines, even with increased boating activity. Emissions of CO and NO_x would increase between 2002 and 2012 as a result of the production and availability of cleaner engines and increased PWC and boating activity, as described for alternative A. CO and NO_x impacts would remain minor and negligible adverse, respectively.

Conclusion. The no-action alternative would have beneficial impacts on air quality because PWC use would be banned, resulting in decreased emissions.

TABLE 24: MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, NO-ACTION ALTERNATIVE

	CO		PM_{10}		HC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	70.1	90.7	1.5	1.3	24.3	15.1	0.8	1.6
Impact Level	Minor	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Because PWC contribution to cumulative air quality impacts would be eliminated, cumulative impacts would be reduced, and would range from negligible adverse for PM_{10}, HC, and NO_x, to minor adverse for CO. Future emission levels would remain relatively stable, with increased CO emissions and slightly increased NO_x emissions as a result of increased boating activity and the conversion to cleaner engines. With improved emission controls, future emissions of HC and PM_{10} would continue to decline, but impacts would remain negligible to minor and adverse.

The implementation of this alternative would not impair air quality.

IMPACT TO AIR QUALITY RELATED VALUES FROM PWC POLLUTANTS

Impacts on environmental resources and values include visibility and biological resources (specifically ozone effects on plants) that may be affected by airborne pollutants emitted from personal watercraft and other sources. These pollutants include O_3, NO_x, HC and $PM_{2.5}$. $PM_{2.5}$ and NO_x emissions are evaluated for visibility impairment. HC and NO_x are precursors to the formation of ozone and are evaluated in lieu of ozone emissions.

To assess the impact of ozone on plants, the five-year ozone index value was calculated and is represented as SUM06. The Air Resources Division of the National Park Service, based on local monitoring site data, developed SUM06 values used in this analysis.

To assess a level of impact on air quality related values from airborne pollutants, both the emissions of each pollutant related to motorized watercraft activity and the background air quality must be evaluated and then considered according to the thresholds defined below.

	Activity Analyzed		**Current Air Quality**
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	There are no perceptible visibility impacts (photos or anecdotal evidence). **and** There is no observed ozone injury on plants. **and** SUM06 ozone is less than 12 ppm-hr.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	SUM06 ozone is less than 15 ppm-hr.
Moderate:	Emissions would be greater than 100 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on past visual observations).	**or**	Ozone injury symptoms are identifiable on plants. **and** SUM06 ozone is less than 25 ppm-hr.
Major:	Emissions would be equal to or greater than 250 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on modeling or monitoring).	**and**	Ozone injury symptoms are identifiable on plants. **or** SUM06 ozone is greater than 25 ppm-hr.

Impairment — Air quality related values in the park would be adversely affected. In addition, impacts would:

- have a major adverse effect on park resources and values; and
- contribute to deterioration of the park's air quality to the extent that the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement; or
- affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

According to NPS's SUM06 ozone index maps for year 2000, the ozone level for the recreation area is 19–25 ppm-hr based on rural monitoring sites.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC use on Curecanti would be reinstated according to management strategies in place until November 6, 2002. There would be no locational restrictions or changes in speed limits from those previously enforced. As outlined in the "PWC and Boating Use Trends" section, annual use is estimated to be 792 PWC in 2002, increasing at approximately 2% annually to 965 PWC in 2012.

Table 25 presents the annual PWC emissions, SUM06 data, and qualitative assessment of visibility and ozone-related effects for 2002 and 2012 under this alternative. Emissions of each pollutant would be less than 50 tons/year in both 2002 and 2012. The SUM06 ozone data show ozone in the region to be in the range of 19 to 25 ppm-hrs, which indicates a moderate adverse impact; however, this value reflects emissions from all local and regional sources of which PWC are a very small component. Therefore, the impact of PWC operation on air quality related values would be classified as minor adverse.

Cumulative Impacts. The cumulative impact analysis includes other motorized watercraft use, taking into consideration regional use trends, as well as current and future emission levels. Cumulative emissions and impacts of all PWC watercraft and other boating activities under alternative A are shown in table 26.

HC, NO_x and $PM_{2.5}$ emissions would be less than 50 tons/year for both years 2002 and 2012. There are likely to be minor cumulative adverse impacts for ozone exposure for year 2002. As described above, although SUM06 ozone values for the region are in the range of 19–25 ppm-hours, local park emissions would contribute a small fraction. Predicted year 2012 regional SUM06 ozone levels would be in the same range as year 2002.

Conclusion. Minor adverse impacts to air quality related values from PWC and from cumulative emissions from motorized boats and PWC would occur in both 2002 and 2012. This conclusion is based on pollutant emissions that would be less than 50 tons per year, no observed visibility impacts or ozone-related plant injury, and regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations.

Implementation of this alternative would not result in an impairment of air quality related values.

TABLE 25: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS, ALTERNATIVE A

Emissions (tons/year)						Visibility Observations and Forecast		Impact Level	
HC		NO_x		$PM_{2.5}$					
2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
4.7	2.9	<0.1	0.1	0.2	0.2	No perceptible visibility impacts	No perceptible visibility impacts	Minor	Minor
				Local Ozone Effects		SUM06 Index Value			
Ozone injury to plants (injury symptoms and ozone monitoring data)				No park specific effects documented	No park specific effects anticipated	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than 2002)		

Source for SUM06 values: NPS Air Quality Division year 2000 monitoring data.

TABLE 26: AIR QUALITY RELATED IMPACTS FROM PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE A

Emissions (tons/year)						Visibility Observations and Forecast		Impact Level	
HC		NO_x		$PM_{2.5}$					
2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
29.0	18.0	0.8	1.7	1.6	1.3	No perceptible visibility impacts	No perceptible visibility impacts	Minor	Minor
				Local Ozone Effects		SUM06 Index Value			
Ozone injury to plants (injury symptoms and ozone monitoring data)				No park specific effects documented	No park specific effects anticipated	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than 2002)		

Source for SUM06 values: NPS Air Quality Division year 2000 monitoring data.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Under this alternative, the annual number of personal watercraft using Curecanti would be the same as alternative A. Additional management prescriptions in alternative B would not affect current and predicted future PWC use numbers. Thus, the predicted emissions levels and direct, indirect, and cumulative impacts of continued PWC use to air quality related values within the unit would be the same as those described for alternative A based on annual emission rates.

Cumulative Impacts. The cumulative impact analysis includes other motorized watercraft use, taking into consideration regional use trends, as well as current and future emission levels. Cumulative emissions and impacts of all PWC watercraft and other boating activities under alternative A are shown in table 26.

HC, NO_x and $PM_{2.5}$ emissions would be less than 50 tons/year for both years 2002 and 2012. There are likely to be minor cumulative adverse impacts for ozone exposure for year 2002. As described above, although SUM06 ozone values for the region are in the range of 19–25 ppm-hours, local park emissions would contribute a small fraction. Predicted year 2012 regional SUM06 ozone levels would be in the same range as year 2002.

Conclusion. The impacts of alternative B would be the same as alternative A. Minor adverse impacts to air quality related values from PWC and from cumulative emissions from motorized boats and PWC would occur in both 2002 and 2012. This conclusion is based on pollutant emissions that would be less than 50 tons per year, no observed visibility impacts or ozone-related plant injury, and regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations.

Implementation of this alternative would not result in an impairment of air quality related values.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Under the no-action alternative PWC use would be banned. This would result in no PWC emissions of HC, NO_x or $PM_{2.5}$. This small reduction in emissions would result in a beneficial impact to air quality related values.

Cumulative Impacts. While PWC use would no longer be allowed within the unit, other motorized watercraft would operate at the use levels described in the "PWC and Boating Use Trends" section, and the area would continue to be influenced by other sources of $PM_{2.5}$ and ozone. Cumulative impacts to air quality related values are shown in table 27. Emissions would be less than in other alternatives because of the elimination of personal watercraft. Impacts to air quality related values would be minor adverse, as discussed for alternative A, because of existing and anticipated regional SUM06 ozone levels.

Conclusion. Under the no-action alternative, HC, NO_x, and $PM_{2.5}$ emissions would be less than if PWC were in use at Curecanti. There would be minor adverse impacts to air quality related values from emissions from motorized boats, without PWC, in both 2002 and 2012. This conclusion is based on regional SUM06 values, with very little influence from existing or forecast Curecanti watercraft operations.

Implementation of this alternative would not result in an impairment of air quality related values.

SOUNDSCAPES

The primary soundscape issue relative to PWC use is that other visitors may perceive the sound made by personal watercraft as an intrusion or nuisance, thereby disrupting their experiences. This disruption is generally short term because personal watercraft travel along the shore to outlying areas. However, as PWC use increases and concentrates at beach areas, related noise becomes more of an issue, particularly during certain times of the day. Additionally, visitor sensitivity to PWC noise varies from fisherman (more sensitive) to swimmers at popular beaches (less sensitive).

TABLE 27: AIR QUALITY RELATED IMPACTS FROM MOTORIZED BOAT EMISSIONS, NO-ACTION ALTERNATIVE

Emissions (tons/year)						Visibility Observations and Forecast		Impact Level	
HC		NO_x		$PM_{2.5}$					
2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
24.3	15.1	0.8	1.6	1.4	1.2	No perceptible visibility impacts	No perceptible visibility impacts	Minor	Minor
				Local Ozone Effects		SUM06 Index Value			
Ozone injury to plants (injury symptoms and ozone monitoring data)				No park specific effects documented	No park specific effects anticipated	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than 2002)		

Source for SUM06 values: NPS Air Quality Division year 2000 monitoring data.

GUIDING REGULATIONS AND POLICIES

The national park system includes some of the quietest places on earth as well as a rich variety of sounds intrinsic to park environments. These intrinsic sounds are recognized and valued as a park resource in keeping with the NPS mission (*Management Policies 2001,* sec. 1.4.6), and are referred to as the park's natural soundscape. The natural soundscape, sometimes called natural quiet, is the aggregate of all the natural sounds that occur in parks, absent human-caused sound, together with the physical capacity for transmitting the natural sounds (*Management Policies 2001,* sec. 4.9). It includes all of the sounds of nature, including such "non-quiet" sounds as birds calling, waterfalls, thunder, and waves breaking against the shore. Some natural sounds are also part of the biological or other physical resource components of parks (e.g., animal communication, sounds produced by physical processes such as wind in trees, thunder, running water).

NPS policy requires the restoration of degraded soundscapes to the natural condition whenever possible, and the protection of natural soundscapes from degradation due to noise (undesirable human-caused sound) (*Management Policies 2001,* sec. 4.9). The National Park Service is specifically directed to "take action to prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored" (*Management Policies 2001,* sec. 4.9). Overriding all of this is the fundamental purpose of the national park system, established in law (e.g., 16 USC 1 et seq.), which is to conserve park resources and values (*Management Policies 2001*. sec. 1.4.3). NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values (*Management Policies 2001,* sec 1.4.3).

Noise can adversely affect park resources, by modifying or intruding upon the natural soundscape. Noise can indirectly impact resources, for example by interfering with sounds important for animal communication, navigation, mating, nurturing, predation, and foraging functions. Noise impacts to non-human species are discussed in the "Threatened, Endangered, and Special Concern Species" section of this environmental assessment.

Noise can also adversely impact park visitor experiences. The term "visitor experience" can be defined as the opportunity for visitors to experience a park's resources and values in a manner appropriate to the park's purpose and significance, and appropriate to the resource protection goals for a specific area or management zone within that park. In other words, visitor experience is primarily a resource-based opportunity appropriate to a given park or area within a park, rather than a visitor-based desire. Noise impacts to visitor experience can be especially adverse when management objectives for visitor experience include solitude, serenity, tranquility, contemplation, or a completely natural or historical environment. Management objectives for resource protection and visitor experience are derived through well-established public planning processes from law, policy, regulations, and management direction applicable to the entire national park system and to each specific park unit.

Visitor uses of parks will only be allowed if they are appropriate to the purpose for which a park was established, and if they can be sustained without causing unacceptable impacts to park resources or values (*Management Policies 2001,* sec. 8.1 and 8.2). While the fundamental purpose of all parks also includes providing for the "enjoyment" of park resources and values by the people of the United States, enjoyment can only be provided in ways that leave the resources and values unimpaired for the enjoyment of future generations (*Management Policies 2001,* sec. 1.4.3). Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that unreasonably interfere with "the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park" (*Management Policies 2001,* sec. 8.2). While many visitor activities are allowed or even encouraged in parks consistent with the above policies, virtually all visitor activities are limited or restricted in some way (e.g., through carrying capacity determinations, implementation plans, or visitor use management plans), and on a park or area specific basis, some visitor activities are not allowed at all.

The degree to which a given activity (e.g., PWC use) is consistent with, or moves the condition of a resource or a visitor experience toward or away from a desired condition, is one measure of the impact of the activity.

The federal regulation pertaining to noise abatement for boating and water use activities (36 CFR 3.7, current draft) prohibits operating a vessel on inland waters "so as to exceed a noise level of 82 decibels measured at a distance of 82 feet (25 meters) from the vessel" and specifies that testing procedures to determine such noise levels should be in accordance with or exceed those established by the Society of Automotive Engineers (SAE) in "Exterior Sound Level Measurement Procedure for Pleasure Motorboats" (J34). This SAE procedure specifies that sound level measurements be taken 25 meters perpendicular to the line of travel of the vessel at full throttle (SAE 2001). It is important to note that this NPS regulation and the SAE procedure were developed for enforcement purposes, not impact assessment purposes. The noise level in the regulation does not imply that there are no impacts to park resources or visitor experiences when watercraft noise is within the regulatory limits; it just indicates that noise levels from vessels legally operating on NPS waters will be no "louder" than 82 dBA at 25 meters distance.

In addition to NPS policies, the state of Colorado has adopted legislation that regulates PWC operation. The following elements of Colorado PWC regulations may have impacts on recreation area soundscapes (Colorado State Parks 2001):

- Timing restrictions. Personal watercraft cannot be used one-half hour after sunset to one-half hour before sunrise.

- Speed restrictions. No PWC may be operated in excess of 40 mph.

- A two-person PWC can be used for water-skiing if there is an operator, an observer and the skier.

- No careless or reckless PWC operation by becoming airborne while crossing the wake of another vessel at an unsafe distance, unsafely weaving through traffic, or operating at such a speed and proximity to another vessel that the operator of either vessel must swerve or abruptly cut speed in order to avoid a collision.

- Sound Restrictions. No vessel may emit a sound level in excess of 86 dBA when measured from a distance of 50 feet or more.

METHODOLOGY AND ASSUMPTIONS

The methodology used to assess PWC-related noise impacts in this document is consistent with NPS *Management Policies 2001, Director's Order #47: Soundscape Preservation and Noise Management,* and the methodology being developed for the reference manual for DO #47 (NPS 2000b). Specific factors at Curecanti related to context, time, and intensity are discussed below and are then integrated into a discussion of the impact thresholds used in this analysis.

Context: Existing background noise levels at Curecanti are influenced by wave action, wind, visitor activities, other boats, and automobile traffic. The soundscape at the high use area of Elk Creek is influenced by automobiles and visitor activities, including PWC and other boats, during the busy summer months. In other areas of Blue Mesa Reservoir, especially away from U.S. 50 and in or near the flat-wake speed zones, natural sounds are evident.

Time Factors: *Time Periods of Interest* — PWC use at Curecanti occurs primarily from June through September, with negligible use in October and May. On summer days, PWC are estimated at approximately 7% of the total number of annual watercraft on the reservoir; in June and September, PWC use is approximately 3%. On a daily basis, PWC use peaks during mid-day and generally stops during periods of inclement weather (e.g., cold, and thunderstorms).

Time periods of greater sensitivity to noise impacts include sunset, sunrise, and nighttime when visitors may be in camp, and when wildlife may be more active.

Duration and Frequency of Occurrence of Noise Impacts — In areas of concentrated PWC use, noise from personal watercraft (and other boat types) can be present intermittently from early morning to sunset. In areas of lower use, noise from personal watercraft (and other boat types) can be occasional, usually lasting a few minutes. On peak holidays, an average of 16 PWC are used on Blue Mesa Reservoir, with 9 PWC being more typical for a summer day.

Intensity: Personal watercraft-generated noise varies from vessel to vessel. The National Park Service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris Miller Miller & Hanson, Inc. 2002). The results show that maximum personal watercraft noise levels at 25 meters (82 feet) ranged between 68 to 76 dBA scale. Noise levels for other motorboat types measured during that study ranged from 65 to 86 decibels at 25 meters (82 feet). Visitors 100 feet from a personal watercraft may be exposed to noise levels of approximately 66 to 74 dBA. The severity of impact may also be affected by variations in noise levels that result from rapid changes in acceleration or direction.

Context, time, and intensity together determine the level of impact for an activity. For example, noise for a certain period and intensity would be a greater impact in a highly sensitive context, and a given intensity would be a greater impact if it occurred more often, or for longer duration. It is usually necessary to evaluate all three factors together to determine the level of noise impact. In some cases an analysis of one or more factors may indicate one impact level, while an analysis of another factor may indicate a different impact level, according to the criteria below. In such cases, best professional judgment based on a documented rationale must be used to determine which impact level best applies to the situation being evaluated.

PWC noise travels in relationship to the speed of the craft, the distance from shoreline, and other influences. To estimate the relative impacts of PWC use, the following methodology was applied:

1. Data from the 2001 watercraft noise study at Glen Canyon was used to estimate the average decibel levels of personal watercraft.

2. Areas of shoreline use by other visitors were identified in relation to where personal watercraft launch and operate offshore. Personal observation from park staff and monthly use reports were used to identify these areas, as well as determine the number of personal watercraft and timeframes of use.

3. Other considerations, such as topography and prevailing winds, were then used to identify areas where PWC noise levels could be exacerbated or minimized.

Sound levels generated by motorized craft using the recreation area are expected to affect recreational users differently. For example, visitors participating in less sound-intrusive activities such as camping would likely be more adversely affected by PWC noise than another PWC or motorboat user. Therefore, impacts to soundscape must take into account the effect of noise levels on different types of recreational users within the impact analysis area. The following is a list of other considerations for evaluating sound impacts:

- The average number of PWC on typical summer days is 9 per day, which under present trends is expected to increase to approximately 11 per day by 2012. On peak use days, such as the 4th of July, that number could be 16 in 2002 and increase to 20 per day in 2012.

- Personal watercraft commonly operate farther than 150 feet from the shoreline; the farther from shore, the lower the noise level to shoreline visitors.

- Noise levels within flat-wake speed zones are less than at full throttle and occur for short durations.

- Ambient noise levels at most locations include wind, waves, automobiles, other visitors, and other motorboats. At Curecanti, PWC use can be up to 7% of total watercraft during the peak season of PWC use, which is generally in July and August

IMPACT ANALYSIS AREA

The impact analysis area for soundscapes is related to the area of PWC use and the distance that PWC noise travels. PWC are allowed to operate in locations on Blue Mesa Reservoir as indicated on the alternatives maps. The state requires that vessels passing within 150 feet of any swimming area, moored vessel, person on shore engaged in fishing, or person in a vessel engaged in servicing buoys or markings,

reduce speed in order to prevent wash or wake of the vessel from causing damage or inconvenience. U.S. 50 runs along Blue Mesa Reservoir, often close to the shoreline, providing a relatively high ambient automobile noise.

PWC noise is reduced over distance. Compared to the noise level at a distance of 50 feet, a reduction of approximately 34 dBA would be expected over a distance of 0.75 mile, with the noise from a single PWC reduced to 34–42 dBA, which is less than daytime ambient noise levels in the more populated recreation areas. Noise levels would be greater with multiple watercraft or where noise may be reflected off canyon walls. Thus, the impact analysis area for soundscapes will be taken as the reservoir area, shoreline, and the 0.75-mile inland shore area.

IMPACT TO VISITORS FROM NOISE GENERATED BY PERSONAL WATERCRAFT

After estimating the number of personal watercraft, the range of relative noise generated by them, and the potential areas where noise concentrations and effects on other visitors may be of concern, the following thresholds were used as indicators of the magnitude of impact for each of the PWC management alternatives:

Negligible: Natural sounds would prevail; motorized noise would be very infrequent or absent, mostly immeasurable.

Minor: Natural sounds would predominate in areas where management objectives call for natural processes to predominate, with motorized noise infrequent at low levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise could be heard frequently throughout the day at moderate levels, or infrequently at higher levels, and natural sounds could be heard occasionally.

Moderate: In areas where management objectives call for natural processes to predominate, natural sounds would predominate, but motorized noise could occasionally be present at low to moderate levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise would predominate during daylight hours and would not be overly disruptive to noise-sensitive visitor activities in the area; in such areas, natural sounds could still be heard occasionally.

Major: In areas where management objectives call for natural processes to predominate, natural sounds would be impacted by human noise sources frequently or for extended periods of time at moderate intensity levels (but no more than occasionally at high levels), and in a minority of the area. In areas where motorized noise is consistent with park purpose and zoning, the natural soundscape would be impacted most of the day by motorized noise at low to moderate intensity levels, or more than occasionally at high levels; motorized noise would disrupt conversation for long periods of time and/or make enjoyment of other activities in the area difficult; natural sounds would rarely be heard during the day.

Impairment: The level of noise associated with PWC use would be heard consistently and would be readily perceived by other visitors throughout the day, especially in areas where such noise would potentially conflict with the intended use of that area. In addition, these adverse, major impacts to park resources and values would:

- Contribute to deterioration of the park's soundscape to the extent that the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement;

- Affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

- Affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. As stated in the "PWC and Boating Use Trends" section and in the "Methodology" section, PWC use levels are projected to range from 16 to 20 craft on a typical high use day over the next 10 years. The distribution of personal watercraft under this alternative would continue the same pattern of use that existed prior to closure. Due to the accessible size of Curecanti, PWC generally distribute themselves throughout Curecanti, although the density of PWC can be higher near the launch areas and shoreline use areas such as Elk Creek. This is due to the way PWC are used by a group of visitors at the park. Typically, there are several people per PWC who take turns riding. A PWC will return to the area where the group is picnicking/camping to rest or switch riders. From park observations, PWC generally run at higher speeds (and higher noise levels) after they have left the launch or picnic/camping areas and have gotten out into open water. The state requires that vessels passing within 150 feet of any swimming area, moored vessel, person on shore engaged in fishing, or person in a vessel engaged in servicing buoys or markings, reduce speed in order to prevent wash or wake of the vessel from causing damage or inconvenience. There are picnic and other shoreline use areas where PWC can operate closer to shore, if no swimmers are present.

The primary shoreline use area is at Elk Creek, where a large marina services the abundant anglers. Users at the picnic areas or swimming areas at those locations are exposed to PWC noise as they come in and out of the shore area if allowed, and from noise of several PWC that may be operating at higher than flat-wake speeds in the vicinity. The impact from a PWC coming into the shore area is dependent on how soon the operator slows down and at what speeds they approach the shoreline. One PWC operating at 50 feet from shore at 40 mph, the maximum speed allowed by Colorado law, would generate noise levels of approximately 78 dBA to a shoreline observer; at 20 mph, the noise level would be approximately 73 dBA. At a distance of 100 feet, the noise level would be approximately 6 dBA less. The noise level from two identical watercraft would be 3 dBA higher than from a single vessel. The EPA-mandated conversion to four-stroke engines could have a beneficial effect in the reduction of noise. Speed restrictions under this alternative would have a beneficial impact on the park's soundscape. With new designs of personal watercraft, engines may be quieter.

Overall, noise levels from personal watercraft would be expected to have minor to moderate adverse impacts at certain locations along the reservoir on days when PWC use was relatively heavy. Minor impacts would occur where use is infrequent and distanced from other park users, for example, as PWC users operated far from shore. Moderate impacts could occur from concentrated PWC use in one area, particularly in the narrow canyon between Cebolla and Iola Basins near Elk Creek, where motorized noise could predominate on busy summer weekends. On the highest PWC use days of the year, such as a Saturday on the Fourth of July holiday weekend, motorized noise could predominate for most of the day at Elk Creek marina. Although noise levels may be bothersome for some, most visitors to Curecanti on a busy holiday weekend will expect to hear motorized noises, and PWC and other motorized use is consistent with park purpose of supplying visitors with water-based recreational opportunities.

Cumulative Impacts. Other noise sources in Curecanti include natural sounds such as waves or wind, automobiles on U.S. 50, other boats operating on Blue Mesa Reservoir, and other visitor activities. Boating activities at Curecanti are capable of generating noise levels higher than PWC due to the number of motorboats, (93% of total motorized use), their area of operation, and noise characteristics of motorboats, which operate at similar and higher noise levels than PWC. Although many motorboats can generate higher sound levels than PWC, they are generally not perceived to be as annoying due to their more typical steady rate of speed and direction.

The cumulative effect of PWC and boating noise would have a minor to moderate adverse impact because it would be heard occasionally throughout the day. Impacts are generally short term, since noise would usually be of limited duration, except on very busy holidays when motorized noise from PWC, other motorboats, automobiles, and other human-caused sounds can predominate for most of the day at the high use, near shore recreation areas such as Elk Creek.

Other visitors would also contribute to the soundscape, including beach users, picnickers, and campers. However, these sounds are considered more acceptable and compatible with typical uses within the national recreation area. Visitor noise has a negligible adverse effect on the soundscape at Curecanti. Impacts are short term, since noise would usually be present for limited duration.

Conclusion. Noise from PWC would have minor to moderate adverse impacts at most locations on Blue Mesa Reservoir and immediate surrounding area. Impact levels would be related to the number of personal watercraft operating as well as the sensitivity of other visitors.

Cumulative noise impacts from personal watercraft, motorboats, automobiles, and other visitors would be minor to moderate adverse because these sounds would be heard occasionally throughout the day, and may predominate on busy days during the high use season.

Implementation of this alternative would not result in an impairment of soundscape values.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Under alternative B, use areas for PWC operation would be the same as alternative A with added restriction areas.

Overall, alternative B would result in a reduction in noise levels experienced by other park visitors, including fisherman and shoreline and near shoreline users of the swimming, picnic, and camping areas. The most apparent noise reductions would occur in the areas where location restrictions and speed restrictions would be added. The magnitude of noise reduction near the buffer zones and speed restriction areas would be dependent on the new speed limits. As described in the analysis for alternative A, a reduction from 40 mph to 20 mph would reduce PWC noise levels approximately 5 dBA. Negligible adverse noise reduction would occur with reductions in speed limit below 20 mph. The types and levels of adverse impacts to the soundscape of other parts of Curecanti would be generally the same as for alternative A, including the minor impacts when use is occasional and distanced from other park users, and moderate impacts from concentrated use in one area, particularly near Elk Creek.

This alternative would result in a minor to moderate adverse impact on the soundscape of Curecanti. Impacts would generally be short-term, although could periodically be longer-term at shoreline areas on the very high use days, where motorized noise may predominate off and on for most of the day. Most visitors to Curecanti during those high use periods expect to hear motorized craft during the day, as

Curecanti is known by the mostly local and regional users for providing this and other recreational opportunities.

Cumulative Impacts. Impact types and overall threshold levels would be similar to those of alternative A. Other noise sources in Curecanti include natural sounds such as waves or wind, other boats operating on Blue Mesa Reservoir, automobiles on U.S. 50, and other visitor activities. Boating activities in the reservoir are capable of generating noise levels higher than PWC due to the number of motorboats, (93% of total motorized use), their area of operation (which is similar to PWC), and noise characteristics of motorboats, which can operate at higher noise levels than PWC. Although many motorboats can generate higher sound levels than PWC, they are generally not perceived to be as annoying due to their more typical steady rate of speed and direction.

Conclusion. Noise from PWC would have minor to moderate adverse impacts at most locations at Curecanti and immediate surrounding area. Impact levels would be related to the number of personal watercraft operating as well as the sensitivity of other visitors. Cumulative noise impacts from personal watercraft, motorboats, automobiles on U.S. 50, and other visitors would be minor to moderate adverse because these sounds would be heard occasionally throughout the day, and may predominate on busy days during the high use season.

The lake arms and buffer zones would have speed and wake restrictions that would provide beneficial improvements to the soundscape values.

Implementation of this alternative would not result in an impairment of soundscape values.

Impacts of No-Action Alternative: Allow No PWC Use

Analysis. Under the no-action alternative PWC would be banned from operating within Curecanti. The removal of PWC would improve the soundscapes where PWC use has been traditionally high, for example, at Elk Creek. Noise created by PWC would not impact fishermen, campers, or other park visitors. This elimination of PWC noise would result in an occasionally noticeable, beneficial effect because personal watercraft comprise approximately 7% of total motorized watercraft use at the park on high-use days.

Cumulative Impacts. Cumulative impacts for the no-action alternative would include the type of impacts associated with other alternatives, since other motorized boating activities would continue to create noise impacts throughout the day and in many locations of the reservoir. PWC use is estimated to be up approximately 7% of summertime motorized use and the elimination of PWC would have a beneficial effect on the level of noise present on and near the reservoir.

Other uses also contribute to the area's soundscape, including swimming, picnicking, and camping. However, these sounds are considered more acceptable and compatible with other uses. Visitor noise has a negligible adverse effect on the natural soundscape at the park.

Conclusion. The decrease in park noise levels with the removal of PWC would have an occasionally noticeable, beneficial effect on the soundscape on the high use days because personal watercraft compromise approximately 7% of total watercraft use. Cumulative noise impacts from motorboats and other visitor activities would result in a beneficial impact to the soundscape.

This alternative would not result in an impairment of soundscape values.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that PWC use affects wildlife by causing interruption of normal activities, alarm or flight, avoidance or degradation of habitat, and effects on reproductive success. This is thought to be a result of a combination of PWC speed, noise and ability to access sensitive areas, especially in shallow-water depths.

Waterfowl and nesting birds are the most vulnerable to PWC. Fleeing a disturbance created by PWC may force birds to abandon eggs during crucial embryo development stages, prevent nest defense from predators, and contribute to stress and associated behavior changes.

Impacts to sensitive species, such as the bald eagle, are documented under the "Threatened, Endangered, or Special Concern Species" section.

GUIDING REGULATIONS AND POLICIES

The NPS *Organic Act*, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the National Park Service to mean that native animal life should be protected and perpetuated as part of the park's natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. According to NPS *Management Policies 2001,* the restoration of native species is a high priority (sec. 4.1). Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and the ecological integrity of plants and animals.

Other regulations regarding wildlife at Curecanti include Colorado Division of Wildlife hunting regulations.

METHODOLOGY AND ASSUMPTIONS

Potential impacts to wildlife and wildlife habitat were evaluated based on the pattern of PWC use in Blue Mesa Reservoir, the nature of habitats and species present, and the professional judgment of the project team and members of the park staff. Information on vegetation communities was available from existing NPS reports and public information sources. The park staff biologist, the U.S. Fish and Wildlife Service, the Colorado Department of Natural Resources, and the Colorado Natural Heritage Program provided wildlife information. To assess impacts from PWC use on wildlife, the following assumptions were made:

1. The majority of PWC users operate their craft in a lawful manner.

2. PWC users who disembark on the shore would travel no more than 100 feet inland and would follow existing trails.

3. Approximately 16 PWC are on Blue Mesa Reservoir during a peak summer day such as the Fourth of July for an average of 2 hours per day.

4. Generally, impacts are expected to be similar or slightly greater in 2012 relative to 2002 due to the slight increase in PWC use at Curecanti of 2% per year. Approximately 20 PWC would be on the water in 2012 on a peak use day such as Fourth of July.

Some research shows that PAH, including those from personal watercraft emissions, adversely affect water quality via harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (EPA 1998, Oris et al. 1998, Landrum et al. 1987, Mekenyan et al. 1994, Arfsten et al. 1996).

IMPACT ANALYSIS AREA

The focus of this study is the shoreline within Curecanti National Recreation Area. PWC noise may disturb wildlife along the shore, extending inland approximately 200 feet. This 200-foot inland area is assumed to provide an encompassing range of assessment based on the distance of PWC operation from the shoreline and wildlife responses to PWC activity.

IMPACT OF PWC USE AND NOISE ON WILDLIFE AND HABITAT

The following thresholds were used to determine the magnitude of effects on wildlife and wildlife habitat:

Negligible: No wildlife species are present; no impacts or impacts with only temporary effects are expected.

Minor: Non-breeding animals are present, but only in low numbers. Habitat is not critical for survival; other habitat is available nearby. Occasional flight responses by wildlife are expected, but without interference with feeding, reproduction, or other activities necessary for survival.

Moderate: Breeding animals are present; animals are present during particularly vulnerable life-stages such as migration or juvenile stages; mortality or interference with activities necessary for survival are expected on an occasional basis, but are not expected to threaten the continued existence of the species in the park.

Major: Breeding animals are present in relatively high numbers, and/or wildlife are present during particularly vulnerable life stages. Habitat targeted by PWC use or other actions has a history of use by wildlife during critical periods and is somewhat limited. Mortality or other effects are expected on a regular basis and could threaten the continued survival of the species in the park.

Impairment: Some of the major impacts described above might be an impairment of park resources if their severity, duration, and timing resulted in the elimination of a native species or substantial population declines in a native species, or they precluded the park's ability to meet recovery objectives for a listed species. In addition, these adverse, major impacts to park resources and values would:

- Contribute to deterioration of the park's wildlife resources and values to the extent that the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement;

- Affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

– Affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC use could affect wildlife wherever motorized vessels are allowed. Although PWC is allowed throughout the main body and arms of Blue Mesa Reservoir, use is most concentrated between Elk Creek and the Lake City Bridge, and in the Soap Creek Arm. Most access is from the Ponderosa Campground and the Elk Creek Marina. Due to cool ambient air and water temperatures throughout the majority of the year, PWC use occurs from June through September with peak use during July and August. Due to heavy winds and wave action on Blue Mesa Reservoir, average time of use for PWC per day is 2 hours.

Within the impact analysis area, wildlife such as waterfowl are most likely to occur near the shoreline due to habitat constraints. Some species such as small mammals may visit the shoreline often, even though their primary habitat is outside of the immediate shoreline area. Other wildlife species that occur within the recreation area occur at the shoreline only infrequently. There are no documented cases of deliberate harassment or collisions with wildlife by PWC users on Blue Mesa Reservoir.

The following summarizes the impacts that would be expected from PWC use to the wildlife species and habitat discussed under the "Affected Environment" chapter. In some cases, species that were discussed in the general wildlife description are not likely to occur in the limited area of water and shoreline that is within the study area.

Birds – Overall, there is a lack of breeding habitat for birds within areas utilized by PWC at Curecanti. In addition, most PWC are not used in the spring at Curecanti due to low water and air temperatures, further minimizing the potential for disturbance to breeding individuals. Waterfowl would be more susceptible to PWC use than other bird species, but any impacts would be short-term, and would likely affect foraging or resting individuals. The potential exists for some impacts during brood rearing, but is unlikely due to lack of suitable habitat in areas of high PWC use. Due to a lack of breeding habitat for waterfowl and other birds in areas of PWC use at Curecanti, adverse impacts to waterfowl and associated habitat would be negligible to minor in the short-term.

Fish – PWC could potentially affect fish through pollutant loads and/or physical disturbance. As discussed in the "Water Quality" section of this chapter, reinstated use of PWC under would create pollutant loads that are well below ecotoxicological benchmarks. Therefore, any adverse impacts to fish related to water contamination by PWC at Curecanti would be negligible. Impacts from pollution would not increase due to projected increases in PWC use since overall pollutant loads would be lower in 2012 than current levels as a result of expected marine engine conversions that would comply with EPA industry standards.

Fish generally avoid direct impacts from PWC; thus disturbance to spawning areas within the reservoir would not be expected. The lack of shoreline aquatic vegetation and benthic invertebrate populations at Blue Mesa Reservoir precludes the existence of concentrated shallow water feeding areas that would be susceptible to PWC. Overall, under alternative A, adverse impacts from physical disturbance to fish populations and spawning areas would be negligible in the short term.

Reptiles and Amphibians – Impacts to reptiles and amphibians are most likely to occur in locations where PWC or their users disrupt nesting or breeding sites. Such sites are not common in areas of high PWC use

in Curecanti. Any adverse impacts from these activities at Curecanti under alternative A would be negligible and would be short-term and minor at localized areas only.

Mammals – Impacts to mammals would be negligible to minor adverse since there is little use of the shoreline by most species. Most are either transient visitors from inland, or are parts of the generally acclimated to human intrusion. Aquatic mammals such as beaver are mobile and avoid noise and disturbance associated with PWC use. Their breeding areas are typically in backwater areas not frequented by PWC and adverse impacts would be negligible. In addition, primary habitat areas for large mammals such as deer, elk, and bighorn sheep are in the lake arm areas away from high PWC use or where flat-wake speed restrictions are in place. The most inland and narrow portions of the lake arms are zoned as flat-wake speed areas. Small mammals common to the area such as marmots, skunks, porcupines, and chipmunks generally acclimate easily to human activity and have the ability to avoid impacts. Therefore, any adverse impacts to these species would be minor and short-term.

Cumulative Impacts. Potential cumulative effects to wildlife and wildlife habitat are related to various visitor activities that occur in proximity to wildlife species. Visitors have access to the shoreline by many types of non-personal watercraft, or by automobile and hiking. Non-PWC boating activities account for over 90% of total boating activity in the recreation area. Wildlife routinely exhibit movement or flight response due to disturbance by powerboats. A study in Florida showed no substantial difference in flush distance between the rapid approach of PWC and non-PWC motorized vessels (Rodgers and Schwikert 2002).

Interactions between wildlife and human visitors would be limited because of the low abundance of wildlife within the high use areas and the dispersion of visitors along the shoreline. Shoreline use tends to be concentrated around developed facilities such as marinas, where habitat characteristics are lacking relative to undeveloped shoreline areas. Visitor interactions would not interfere with feeding, reproduction, or other activities necessary for the survival of the wildlife species. Overall, visitors (including PWC users) at Curecanti would cause minor, short-term adverse impacts to wildlife that are dispersed over a large area along the shoreline.

Conclusion. PWC use at Curecanti would have negligible adverse effects on fish, and negligible to minor adverse impacts on waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. Due to low levels of PWC use, coupled with a lack of substantial habitat areas, any impacts to fish, wildlife and respective habitats would be temporary and short term. The intensity and duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers would not increase substantially and engine technology would continue to improve under EPA industry regulations. On a cumulative basis, all visitor activities would have minor adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary and short term.

Implementation of this alternative would not result in impairment to wildlife or wildlife habitat.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Under alternative B, the number of PWC users, launch restrictions, safety/operating restrictions, and emissions requirements would be the same as under alternative A. However, the added 100-foot PWC restricted buffer zone along portions of the south shore, along with expanded wake restricted zones in lake arms would decrease the likelihood of impacts to waterfowl and other species along the shoreline. In the shoreline buffer areas, noise, physical disturbance, and emissions from PWC would be decreased or eliminated. Additional speed and wake restrictions would be implemented in the

lake arm and river inlet areas. The establishment of a resource monitoring program would provide a check on future increases in PWC use. The above restrictions would result in beneficial impacts to wildlife and wildlife habitat relative to alternative A. Over the next 10 years, adverse impacts would continue to be negligible since PWC numbers are not expected to increase substantially. All wildlife impacts would be temporary and short term.

Cumulative Impacts. The cumulative effects of alternative B would be essentially the same as those of alternative A as adverse impacts would be negligible to minor. Current and future impacts by visitors would not differ substantively between alternatives. PWC contribution to cumulative impacts would be slightly less than in alternative A.

Conclusion. Impacts to wildlife in alternative B are similar to those in alternative A, except the additional limitations on PWC use would slightly reduce impacts on wildlife. Expanded wake restrictions and resource monitoring would result in a beneficial impact. Cumulative adverse impacts would be the same as alternative A, and would be negligible to minor adverse due to boating activity and other visitor uses. All wildlife impacts would be temporary and short term.

Implementation of this alternative would not result in impairment to wildlife or wildlife habitat.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Under the no-action alternative, PWC use would not be reinstated on Blue Mesa Reservoir. This would eliminate any potential impacts from PWC to wildlife or habitats, including physical disturbance, noise, or emissions, especially along the reservoir shoreline. There would be beneficial impacts to wildlife similar to those described in alternative B, but to a greater degree due to the elimination of PWC. Any impacts related to disturbance of habit, breeding activity, or feeding related to PWC would no longer occur.

Cumulative Impacts. Cumulative impacts to wildlife would be similar to those described for alternative A. While interactions between PWC users and wildlife would be eliminated, other visitors would still have access to the shoreline and could cause temporary flight responses in wildlife. Cumulative adverse impacts would be negligible to minor, and short term.

Conclusion. PWC users would not be allowed to operate in Blue Mesa Reservoir, resulting in a beneficial impact on wildlife and wildlife habitat, relative to alternative A, due to the elimination of interactions between PWC users and wildlife. The reduction in noise and visitor access could also have a beneficial impact on wildlife, particularly in areas of frequent PWC use, resulting in potential increased use of these areas by wildlife and waterfowl.

Cumulative adverse impacts on wildlife and wildlife habitat from other shoreline visitor activities would continue to be negligible to minor. PWC contribution to overall impacts to wildlife and wildlife habitat would be eliminated.

No impairment of wildlife or wildlife habitat would result from this alternative.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

The same issues described for PWC use and general wildlife also pertain to special status species. Potential impacts from PWC include inducing flight and alarm responses, disrupting normal behaviors

and causing stress, degrading habitat quality, and potentially affecting reproductive success. Special status species at Curecanti National Recreation Area include federally or state listed threatened, endangered, or candidate species. Additionally, some species at Curecanti are designated by the state or other local governments as species of special concern. The park also designates some species as "park native species of special concern."

GUIDING REGULATIONS AND POLICIES

The *Endangered Species Act* (16 USC 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species federally listed as threatened or endangered. If the National Park Service determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

An analysis of the potential impacts to each special status species is included in this section. At Curecanti it has been determined that none of the alternatives is likely to adversely affect any of the listed species. The completed environmental assessment will be submitted to the U.S. Fish and Wildlife Service for its review. If the agency concurs with the finding of the National Park Service, no further consultation will be required.

Formal consultation would be initiated if the National Park Service determined that actions in the preferred alternative would be likely to adversely affect one or more of the federally listed threatened or endangered species identified in the recreation area. At that point a biological assessment would be prepared to document the potential effects. From the date of initiation of formal consultation, the U.S. Fish and Wildlife Service would be allowed 90 days to consult with the National Park Service and 45 days to prepare a biological opinion based on the biological assessment and other scientific sources. The U.S. Fish and Wildlife Service would state its opinion as to whether the proposed PWC activities would be likely to jeopardize the continued existence of the listed species or to result in the destruction or adverse modification of critical habitat. Such an opinion would be the same as a determination of impairment. To ensure that a species would not be jeopardized by PWC activities, the National Park Service would confer with the U.S. Fish and Wildlife Service to identify recommendations for reducing adverse effects and would integrate those into the preferred alternative.

NPS *Management Policies 2001* state that potential effects of agency actions will also be considered regarding state or locally listed species. The National Park Service is required to control access to critical habitat of such species, and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend.

State and federally listed species were identified through discussions with park staff, informal consultation with the U.S. Fish and Wildlife, and with the Colorado Division of Wildlife. A letter requesting a current list of federal threatened, endangered, and other special status species was sent to the U.S. Fish and Wildlife Service.

METHODOLOGY AND ASSUMPTIONS

Primary steps in assessing impacts on listed species were taken to determine the following:

1. Which species are found in areas likely to be affected by management actions described in the alternatives.

2. Current and future use and distribution of personal watercraft by alternative.

3. Habitat loss or alteration caused by the alternatives.

4. Displacement and disturbance potential of the actions and the species' potential to be affected by PWC activities.

The information in this analysis was obtained through best professional judgment of park staff and experts in the field (as cited in the text), and by conducting a literature review.

Basic assumptions were made regarding personal watercraft and visitor activities, as follows:

1. Most PWC users operate their craft in a lawful manner and abide by state laws and park regulations.

2. PWC users who disembark on the shore would travel no more than 100 feet inland and would follow existing trails.

3. PWC use is projected to increase 2% per year now through 2012.

4. Approximately 16 PWC are on Blue Mesa Reservoir during a peak summer day such as the Fourth of July for an average of 2 hours per day.

The PWC and visitor use trends data were used to evaluate impacts to threatened or endangered species. Additional information was obtained from park staff. Vegetation and wildlife information was provided by the Curecanti resource specialist, existing NPS reports, literature reviews, and contacts with the U.S. Fish and Wildlife Service, and Colorado Department of Wildlife.

IMPACT ANALYSIS AREA

The focus of this study is Blue Mesa Reservoir and the surrounding shoreline area inland to approximately 200 feet. This 200-foot inland segment is assumed to provide a more encompassing range of assessment, based on the distance of PWC operation from the shoreline, wildlife responses to PWC activity, and the likely distance PWC users would travel inland.

IMPACT OF PWC USE ON SUCH SPECIES

The *Endangered Species Act* defines the terminology used to assess impacts to listed species as follows:

No effect: When a proposed action would not affect a listed species or designated critical habitat.

May affect / not likely to adversely affect: Effects on special status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.

May affect / likely to adversely affect: When an adverse effect to a listed species may occur as a direct or indirect result of proposed actions and the effect either is not discountable or is completely beneficial.

Is likely to jeopardize proposed species / adversely modify proposed critical habitat (impairment): The appropriate conclusion when the National Park Service or the U.S. Fish and Wildlife Service identifies situations in which PWC use could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC use could affect threatened, endangered, or other special status wildlife wherever use occurs in close proximity to occurrences of listed species or habitat. Although PWC is allowed throughout the main body and arms of Blue Mesa Reservoir, use is most concentrated between Elk Creek and the Lake City Bridge, and in the Soap Creek Arm. Most access is from the Ponderosa Campground and the Lake Fork Marina. PWC use levels are low with approximately 16 PWC users on a peak use summer day in 2002, increasing to an average of 19-20 PWC users per peak use day by 2012. Due to low water and air temperatures throughout the majority of the year, PWC use occurs from June through September with peak use during July and August. Due to heavy winds and wave action on Blue Mesa Reservoir, average time of use for PWC per day is 2 hours.

The following summarizes the impacts that would be expected from PWC use to the federal and state listed endangered, threatened, candidate, and species of concern discussed under the "Affected Environment" chapter. In some cases, species previously discussed in the "Affected Environment" chapter are not likely to occur in the limited area of water and shoreline within the area analyzed for impacts from PWC and other watercraft. Generally, impacts are expected to be similar or slightly greater in 2012 relative to 2002 due to the slight increase of 2% per year in PWC use in the area.

Animals

Federal and State Listed or Candidate Species

Bald eagle (federally and state listed threatened). The Gunnison River and the reservoirs of Curecanti provide a center for wintering activity for bald eagles, as there is ample food for bald eagles within the waters of the area. However, bald eagle nesting along the shoreline of Blue Mesa Reservoir is unlikely due to a lack of sizeable trees suitable for nesting. In addition, PWC activity at Curecanti occurs from June to September with peak use in July and August, and does not coincide with nesting or wintering activity in the area. PWC use within Curecanti National Recreation Area may affect, but is not likely to adversely affect bald eagles or their habitat.

Gunnison sage grouse (federal candidate species). The Gunnison sage grouse is known to breed and nest within Curecanti. Visitor use areas adjacent to known Gunnison sage grouse habitats are closed to public access during the appropriate season. A historic lek site is located near the shoreline of the Stevens Creek campground where PWC use occurs. If this site is determined to be active, through surveys being conducted by the National Park Service, the area would also be closed to public access during the mating and nesting seasons. Further buffer zones would be established in alternative B to reduce noise disturbance during the lek season since acoustics is an important part of the mating ritual. However, since PWC use is not likely to occur during the lek season, March through May 15, due to inclement weather, PWC use may affect, but is not likely to adversely affect, Gunnison sage grouse or its habitat.

Yellow-billed cuckoo (federal candidate for listing). Habitat for the yellow-billed cuckoo consists of old growth riparian woodlands with dense understories (Kingery 1998). At Curecanti, potential habitat for the species would only be found in the riparian areas associated with the inflow drainages where PWC use is either subject to wake restrictions or is prohibited. The yellow-billed cuckoo is designated as a non-game

species within Colorado. As that designation applies, it is not legal to take, harass, or threaten the species. Documented occurrences of yellow-billed cuckoo are infrequent and consist of non-breeding summer records only (Andrews and Righter 1992, Hyde and Cook 1980). There is no evidence that the bird breeds in Gunnison County (Kingery 1998). Therefore, PWC use within Curecanti National Recreation Area may affect, but is not likely to adversely affect the yellow-billed cuckoo or its habitat.

Canada lynx (federally listed threatened, state listed endangered). The Canada lynx could potentially occupy higher elevation areas surrounding Curecanti National Recreation Area, but it is unlikely that the individuals would occur along the shoreline of Blue Mesa Reservoir, as it is well out of primary habitat for the species. PWC use at Curecanti would have no effect on the lynx or habitat for the species.

Boreal toad (federal candidate species, state endangered). Habitat for the boreal toad surrounds Curecanti National Recreation Area, but is not located along the shoreline or within the study area of Blue Mesa Reservoir. Therefore, PWC use at Curecanti National Recreation Area would have no effect on the boreal toad or its habitat.

Colorado River cutthroat trout (federally and state listed vulnerable). The Colorado River cutthroat trout is not known to occur within Blue Mesa Reservoir where PWC would be in use. However, water from Curecanti National Recreation Area flows into downstream habitat for the Colorado River cutthroat trout. However, as discussed in the "Water Quality" section, reinstated use of PWC under alternative A would create pollutant loads that are well below ecotoxicological benchmarks. In addition, the dilution factor of the lower reservoirs would further minimize impacts to the fish. The U.S. Fish and Wildlife Service did not include listed fish species as a concern under this action unless water depletions were involved. PWC use at Curecanti under alternative A would have no effect to the Colorado River cutthroat trout.

State Special Concern Species

American peregrine falcon. The peregrine falcon has been recorded in the vicinity of Blue Mesa Reservoir, and is known to occupy cliff ledges in the nearby Black Canyon of the Gunnison. Foraging activities of the falcons could potentially be affected by PWC use at Curecanti, but any effects would be minimal and short-term. Therefore, PWC use at Curecanti may affect, but is not likely to adversely affect the American peregrine falcon or its habitat.

Greater Sandhill crane. The greater Sandhill crane is known to occur at Curecanti during migration, but is not known to breed in the area. Sandhill crane migratory occurrences at the recreation area take place in spring when water and air temperatures are not conducive to PWC use on Blue Mesa Reservoir. There would be no effect from PWC use at Curecanti National Recreation Area on the greater Sandhill crane or its habitat.

Long-billed curlew. Records exist of occasional occurrences of the long-billed curlew in the vicinity of Curecanti National Recreation Area. Primary habitat for the species in Colorado is on the eastern plains and no breeding evidence exists for Curecanti or areas nearby. The springtime migratory occurrences do not coincide with PWC use on Blue Mesa Reservoir due to cold water and air temperatures. PWC use at Curecanti would cause no effect to the long-billed curlew or its habitat.

Park Sensitive Species

Curecanti National Recreation Area contains species that park staff considers to be native species of special concern. It is NPS policy to consider the effects of its actions to such species.

The great blue heron is a summer resident at the recreation area and may be affected, but is not likely to be adversely affected by PWC use on Blue Mesa Reservoir. Impacts could result from noise and would be most likely to occur if PWC users act illegally and do not adhere to restrictions in sensitive areas such as narrow portions of lake arms where herons are most likely to occur.

Bighorn sheep within Curecanti National Recreation Area are likely to occur in lake arm areas that are protected by flat-wake speed zoning. Disturbance is only likely if PWC users do not adhere to zoning restrictions in these areas. Under alternative A, PWC use on Blue Mesa Reservoir should not affect bighorn sheep or habitat.

Gunnison's prairie dogs inhabit sagebrush grasslands at Curecanti away from the shoreline of Blue Mesa Reservoir and no effect to the species from PWC use under alternative A would be expected.

Black bears are known to occupy the general area around Curecanti and visit the shoreline of Blue Mesa Reservoir infrequently. However, the primary habitat area for bears is away from the reservoir in forested areas. Noise from PWC use at Curecanti may affect black bears; however, adverse effects are unlikely due to lack of preferred habitat within the study area.

Plants

According to the U.S. Fish and Wildlife Service, there are no federally listed or candidate plant species at Curecanti National Recreation Area that would be affected by PWC use on Blue Mesa Reservoir. There are two plant species that occur within the recreation area that are ranked by the Nature Conservancy's Natural Heritage ranking system. The skiff milkvetch (state listed as "critically imperiled") and the Gunnison milkvetch (state listed as "imperiled") occur in upland sagebrush communities within the recreation area, but do not occur along the shoreline of Blue Mesa Reservoir. Visitors could potentially access the populations by PWC, but this ability is not unique to PWC users, as the plants could also be accessed by automobile and other means. Under alternative A, PWC use at Curecanti may affect, but is unlikely to adversely affect special status plant species.

Cumulative Impacts. Cumulative impacts to the special status animal and plant species discussed above include impacts from human presence and all other water-based recreational activities such as boating, swimming, and fishing. In addition, visitors who focus more on upland activities such as picnicking, camping, hiking, and hunting also may cause minor adverse disturbances to the above species in the short term. However, most visitor activities occur in or near already disturbed or developed sites such as boat ramps, marinas, and camp or picnic areas.

Cumulative impacts from activities within Curecanti National Recreation Area may affect but are not likely to affect federally or state listed species or other special status wildlife or plant species in the short term but not in the long term.

Conclusion. PWC use at Curecanti National Recreation Area may affect, but is not likely to adversely affect the federally or state listed bald eagle, Gunnison sage grouse, yellow-billed cuckoo, American peregrine falcon, skiff milkvetch, and Gunnison milkvetch. There would be no effect to all other federal or state listed species. All park sensitive species are unlikely to be affected. Cumulative effects from all park visitor activities would also be unlikely to cause adverse effects to special status species due to lack of species occurrences as well as a lack of access to the species or their habitats in the short or long term.

Implementation of this alternative would not result in impairment of threatened or endangered species.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. This alternative would allow reinstated PWC use but would include additional PWC management strategies. A 100-foot PWC restricted buffer zone would be established along portions of the south shoreline of Blue Mesa Reservoir from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge for soundscape, cultural resource, and wildlife protection as well as erosion prevention. In addition, a resource monitoring program would be established to monitor future impacts. Also, a 100-foot buffer zone would be established for Gunnison sage grouse habitat on the northern shore of the main body at Stevens Creek. Additional speed zones and wake restrictions associated with the buffer zones, lake arms, and river inlets would be established to restrict access as well as reduce erosion.

The establishment of PWC-restricted buffer zones along portions of Blue Mesa Reservoir would potentially have beneficial impacts to threatened and endangered species and other special status species, particularly the Gunnison sage grouse. Effects from PWC noise, physical disturbance, and access would be decreased along these portions of the shoreline. Under alternative B, PWC use in Curecanti National Recreation Area may affect but is not likely to adversely affect bald eagle, yellow billed cuckoo, American peregrine falcon, and both milkvetch species noted in alternative A. As in alternative A, there will be no effect to all other federal or state-listed species, and no likely effects to park sensitive species.

Cumulative Impacts. Cumulative impacts to special status species would be similar to alternative A and would not likely adversely affect listed or park sensitive species or their habitat. Cumulative activities result from water-based activities and shoreline access by other visitors and are concentrated mostly in developed areas rather than in habitat or in areas of frequent occurrence by concerned species.

Conclusion. PWC use may affect, but is not likely to adversely affect, the same federal or state-listed species outlined in alternative A. Elimination of PWC in lake arms could beneficially affect species such as the bighorn sheep and great blue heron. Thus, buffer zones and speed restrictions could result in beneficial impacts to some species, relative to alternative A. While some cumulative disturbance could occur from PWC use, as well as other human activities on the reservoir and shoreline, these activities may affect, but are not likely to adversely affect any of the listed or park sensitive species. There would be no effect to special status species in designated areas where PWC would be prohibited or where additional speed or wake restrictions would be enforced.

No impairment to any listed species would occur under this alternative.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. PWC use would not be reinstated in Curecanti, eliminating any potential impacts to the concerned species from physical disturbance, noise, or emissions from PWC, resulting in beneficial impacts to listed or park sensitive species. Species such as the Gunnison sage grouse are found in some areas of PWC use and could benefit from a continued PWC ban.

Cumulative Impacts. Contribution of PWC to cumulative impacts on federal or state listed animal and plant species would be eliminated. The activities of other visitors would be similar to those in alternatives A and B, and may affect, but are not likely to adversely affect federal or state listed species. Impacts would be temporary and short-term and species are not normally present or accessible to visitor activities.

Conclusion. The elimination of PWC use would result in beneficial effects, relative to alternatives A and B, to some federal or state-listed species such as the Gunnison sage grouse and to some park sensitive

species. There may also be a beneficial impact to special status species of concern due to a ban on PWC use. PWC contribution to cumulative impacts to protected species would be eliminated; however, the cumulative activities of other visitors and other boaters may affect but would not likely adversely affect the listed species similar to the other alternatives.

This alternative would not result in an impairment of threatened or endangered species.

SHORELINES AND SHORELINE VEGETATION

Personal watercraft provide access to the shoreline, and operators may disembark to explore shoreline areas. As a result, vegetation could be trampled by visitors. PWC are able to access areas where other types of watercraft cannot, which may disturb sensitive plant species. In addition, wakes created by personal watercraft may affect shorelines and cause erosion.

GUIDING REGULATIONS AND POLICIES

According to NPS management policy, natural shoreline processes such as erosion, deposition, overwash, inlet formation, and shoreline migration should continue without interference. Where the nature or rate of natural shoreline processes has been altered, the National Park Service is directed to identify alternatives for mitigating the effects of such activities or structures and for restoring natural conditions (NPS *Management Policies 2001,* sec. 4.8.1.1). The National Park Service must also comply with the provisions of Executive Order 11990 ("Protection of Wetlands"), which requires federal agencies to avoid short- and long-term adverse impacts associated with the destruction or modification of wetlands whenever possible

METHODOLOGY AND ASSUMPTIONS

Potential impacts to shoreline vegetation and to the shoreline itself (erosion that can affect shoreline communities) were evaluated based on the pattern of use of motorized watercraft on Blue Mesa Reservoir, the nature of the shoreline and vegetation present, and the professional judgment and observations of park staff. To assess the magnitude of impacts from PWC use on shoreline vegetation, the following assumptions were made:

1. Most PWC users operate their craft in a lawful manner and abide by state laws and park regulations.

2. PWC users who disembark on the shore would travel no more than 100 feet inland and would follow existing trails.

3. PWC use is projected to increase 2% per year now through 2012.

IMPACT ANALYSIS AREA

The impact analysis area for the assessment included the immediate water/land interface along the shoreline of Blue Mesa Reservoir where PWC use is allowed.

IMPACT TO SENSITIVE SHORELINE VEGETATION FROM PWC USE AND VISITOR TRAMPLING

Shoreline vegetation impacts were determined by examining the potential effects of PWC and visitor use on vegetation, according to type and sensitivity. The number of personal watercraft and boats, and their distribution were based on the analysis provided in the "PWC and Boating Use Trends" section. The following impact thresholds were established to describe the relative changes in shoreline vegetation under the various alternatives being considered:

Negligible: Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor: Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate: Impacts would cause a change in the plant community (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized.

Major: Impacts to the plant community would be substantial, highly noticeable, and permanent.

Impairment: PWC use would contribute substantially to the deterioration of the shoreline or shallow water environment to the extent that the park's shoreline or submerged vegetation would no longer function as a natural system. In addition, these adverse major impacts to park resources and values would:

- Contribute to deterioration of these resources to the extent that the park's purpose could not be fulfilled as established in its authorizing memorandum of agreement;
- Affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- Affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. Reinstated PWC use could affect vegetation in areas between Elk Creek and the Lake City Bridge and in the Soap Creek Arm where visitor use and shoreline access is concentrated. Potential impacts to vegetation from PWC use include short-term wave action and trampling as a result of PWC operators accessing and walking on the shore. Because vegetation is generally lacking along many shoreline areas, PWC use would result in only negligible, short-term adverse impacts. The primary location of lush riparian vegetation is in more inland and narrow areas of the lake arms. However, these areas would be designated flat-wake speed areas to minimize disturbance from PWC and other activities. Thus, adverse impacts to vegetation would be negligible in the lake arms as well.

Cumulative Impacts. Shoreline erosion at Curecanti is caused primarily by high winds and wave action and is more likely to affect shoreline vegetation when the reservoir is at full pool. Physical processes in combination with PWC and other watercraft use at Curecanti, would result in a negligible to minor

adverse impacts on shoreline vegetation because it is generally lacking in concentrated use areas or is protected by restrictive zoning.

Conclusion. PWC use would result in a negligible adverse effect on shoreline vegetation because vegetation along the reservoir shoreline is generally lacking. Areas where vegetation may occur would be protected by wake restrictions. Cumulative impacts would be negligible to minor in the long term due to wind-related erosion, wave action, and other visitor activities such as boating.

This alternative would not result in an impairment of shoreline vegetation.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Under this alternative, the 100-foot shoreline buffer along portions of the south shore of Blue Mesa Reservoir would reduce impacts to shoreline vegetation from PWC use by limiting shoreline access. Resource monitoring programs could help reduce the potential for future impacts by providing beneficial feedback on the condition of certain areas. These strategies would result in a beneficial effect on vegetation because they afford some additional protection in comparison to alternative A.

Cumulative Impacts. Cumulative adverse impacts related to other visitors and wind and wave action would be the same as described for alternative A and would be negligible to minor. Because boating comprises approximately 93% of all watercraft use at the park, additional PWC management strategies would not appreciably change impacts.

Conclusion. PWC use would have beneficial impacts to shoreline vegetation over the short and long term relative to alternative A. The shoreline buffer and monitoring that would occur under this alternative would provide some additional protection although shoreline vegetation is limited. Adverse cumulative impacts resulting from boating activity would continue to be negligible to minor.

This alternative would not result in an impairment of shoreline vegetation.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Banning PWC use within the national recreation area would eliminate potential impacts to shoreline vegetation as a result of visitors gaining shoreline access from personal watercraft or from wave action due to PWC. Eliminating PWC use would result in beneficial impacts to shoreline vegetation, similar to the PWC management strategies proposed in alternative B, because shoreline vegetation is lacking in most areas.

Cumulative Impacts. Cumulative impacts would be the same as those described for alternative A except that PWC contribution to these impacts would be eliminated resulting in a beneficial effect. However, use of other motorized vessels (which approximate 93% of all watercraft at Blue Mesa Reservoir), in addition to wind and wave action, would continue to cause negligible adverse impacts.

Conclusion. The elimination of personal watercraft would result in beneficial impacts to shoreline vegetation over the short and long term. Cumulative adverse impacts would continue to be negligible to minor, due to continued boating use and some wind-related erosion.

This alternative would not result in an impairment of shoreline vegetation.

VISITOR USE AND EXPERIENCE

Some research suggests that PWC use is viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects, while others believe personal watercraft are no different from other watercraft and that people have a right to enjoy the sport. The primary concern involves changes in noise, pitch, and volume, due to the way personal watercraft are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2001* state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the National Park Service is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Because many forms of recreation can take place outside a national park setting, the National Park Service will therefore seek to:

- provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in a particular unit

- defer to local, state, and other federal agencies; private industry; and non-governmental organizations to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting

Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that:

- would impair park resources or values

- would create an unsafe or unhealthful environment for other visitors or employees

- are contrary to the purposes for which the park was established

- would unreasonably interfere with the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park; NPS interpretive, visitor service, administrative, or other activities; NPS concessioner or contractor operations or services; or other existing, appropriate park uses

Part of the purpose of Curecanti National Recreation Area is to offer opportunities for recreation, education, inspiration, and enjoyment. Its significance lies in the spectacular and diverse scenic, recreation and cultural resources that visitors enjoy. One of the national recreation area's mission goals is to ensure that "Visitors safely enjoy and are satisfied with the availability, accessibility, diversity and quality of park facilities, services and appropriate recreational opportunities." To achieve this mission goal, two long-term (five-year) visitor goals were identified in the *Strategic Plan* (NPS 2001c)*:*

- *Visitor Satisfaction* — By September 30, 2005, 89% of visitors to Curecanti National Recreation Area are satisfied with appropriate facilities, services, and recreational opportunities.

- *Visitor Safety* — By September 30, 2005, the number of Curecanti National Recreation Area visitor accidents/incidents is no higher than the FY 1992 – FY 1996 five-year annual average of 8.8.

Both goals focus on maintaining high visitor satisfaction by means of appropriate and safe recreational opportunities and experiences.

The authorizing memorandum of agreement directs the park to "provide public recreational facilities; to conserve the scenery, the natural, historic, and archeologic objects, and the wildlife; to provide for public use and enjoyment of the lands and water areas at Curecanti by such means as are consistent with the primary purposes of the overall project; and to provide facilities to mitigate losses of, and improve conditions for, the propagation of fish and wildlife."

METHODOLOGY AND ASSUMPTIONS

The purpose of this impact analysis was to determine if PWC use at Curecanti National Recreation Area is compatible or in conflict with the purpose of the park, its visitor experience goals, and the direction provided by NPS *Management Policies*. Thus, these policies and goals were integrated into the impact thresholds.

To determine impacts, the current level of PWC use was calculated for the recreation area (see the "PWC and Boating Use Trends" section). Staff observations were evaluated to determine visitor attitudes and satisfaction in areas where personal watercraft are used.

The potential for change in visitor experience was evaluated by identifying projected increases or decreases in both personal watercraft and other visitor uses, and determining whether these projected changes would affect the desired visitor experience and result in greater safety concerns or additional user conflicts.

IMPACT ANALYSIS AREA

In terms of PWC use, the impact area was defined as all areas of Curecanti that are open to PWC as described in the *Superintendent's Compendium* (NPS 2002g). This includes the body of Blue Mesa Reservoir from 500 feet above the Blue Mesa Dam upstream to Beaver Creek. Additionally, PWC use may affect visitors at beaches, trails, and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PERSONAL WATERCRAFT ON VISITOR EXPERIENCE GOALS

The following thresholds were defined:

Negligible: Visitors would not likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources.

Minor: Visitors would likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources; however the changes in visitor use and experience would be slight and likely short term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values.

Moderate: Visitors would be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and

experience would be readily apparent and likely long term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values, but visitor satisfaction might be measurably affected (visitors could be either satisfied or dissatisfied). Some visitors who desire to continue their use and enjoyment of the activity/visitor experience would be required to pursue their choice in other available local or regional areas.

Major: Visitors would be highly aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and long term. The change in visitor use and experience proposed in the alternative would preclude future generations of some visitors from enjoying park resources and values. Some visitors who desire to continue their use and enjoyment of the activity / visitor experience would be required to pursue their choice in other available local or regional areas.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC operators under alternative A would have unrestricted use along the Blue Mesa Reservoir shoreline within the impact analysis area, with use increasing from 9 personal watercraft per typical summer season day to 11 PWC per day by 2012. Peak use days would increase from 16 to 20 PWC per day, based on an increase of 2% per year.

Impact on PWC Users — There would be no change to PWC use or activity as compared to conditions prior to the 2002 PWC closure. Alternative A would have no effect on the visitor experience of PWC users at Curecanti National Recreation Area.

Impact on Other Boaters — Other boaters at Curecanti National Recreation Area would interact with PWC operators on an increasing basis as overall boating numbers increase over the next 10 years. PWC use is expected to increase at a slightly higher rate then other boat use; however, PWC would still only comprise approximately 7% of total boats on Blue Mesa Reservoir in 2012. The main body of Blue Mesa Reservoir does not receive substantial PWC use due to the large expanses of open water and frequent high winds. High-use areas for PWC include Dry Creek, the Soap Creek Arm, Bay of Chickens, near the marinas, and off Highway 149 just south of the Lake City Bridge.

Generally, few non-motorized craft (sea kayaks, canoes, and windsurfers) use Blue Mesa Reservoir, so interactions with these user groups would be infrequent. In addition, flat-wake speed areas would occur on the most inland and narrow portions of Soap Creek Arm, West Elk Arm, Lake Fork Arm, Cebolla Arm, the narrow waterways off the Bay of Chickens and Dry Creek, and upstream of the Lake City Bridge – calmer waters that lead to creeks favored by canoeists and kayakers. Flat-wake areas would exist at Elk Creek and Lake Fork Marinas, and Iola, Stevens Creek and Old Stevens boat ramps. However, it should be noted that the main violation by PWC users has historically been violation of flat-wake speed zones, and increased PWC numbers could have an effect on non-motorized boaters at these sites. Some PWC activity exists near the windsurfing beach, but staff observations note that windsurfing activity has been steadily declining over the few years. Therefore, under alternative A, impacts to non-motorized boaters would be negligible to minor adverse.

Motorized boats are more likely to interact with personal watercraft. The most common area for personal watercraft / boater interaction is near the boat launches, as the majority of motorized boats enter the water at the marinas and then motor into the main body of the reservoir for fishing. No accidents involving

PWC and other boaters have been reported in the last five years (1998–2002), although with increasing boater and PWC numbers, the potential for interactions between the user groups would also increase. Based on this analysis, alternative A would have negligible to minor adverse effects on the visitor experience of boaters using non-motorized and other motorized vessels.

Impact on Other Visitors — Campers**,** swimmers, anglers, hikers, and other shoreline visitors to the reservoir would have contact with PWC users. High-use shoreline areas that are popular with both PWC and other shoreline users include the Dry Creek Picnic Area, the Soap Creek Arm, Bay of Chickens, and off Highway 149 just south of the Lake City Bridge. The Dry Creek area attracts 30 to 40 people and five or six PWC on a summer weekend day, with picnicking, swimming, dry-land water-ski starts, cliff diving, and PWC use occurring together. The state requires that vessels passing within 150 feet of any swimming area, moored vessel, person on shore engaged in fishing, or person in a vessel engaged in servicing buoys or markings, reduce speed in order to prevent wash or wake of the vessel from causing damage or inconvenience. When water levels are high, the windsurfing beach near the East Elk Creek campground sees a lot of activity – swimming, fishing, windsurfing, PWC use, and picnicking.

Swimming is permitted in Blue Mesa Reservoir, however there are no designated swim beaches within the recreation area, and swimming is not permitted from docks, launch ramps, and unanchored boats. Swimming and cliff diving activity is common in the Dry Creek Picnic Area, and park staff have received complaints from swimmers in the past about PWC not slowing down in this area. Swimming and PWC use could occur together at the windsurfing beach resulting in conflict. PWC use would have a negligible to minor adverse effect on swimmers.

There are four campgrounds on the reservoir that have boat launch facilities, and thus have PWC use in the vicinity. Receding lake levels have led to decreased visitation at park campgrounds, and because campgrounds are currently high above the reservoir level, contact between campers and PWC users is low. However, lake levels could rise, camping visitation could increase, and contact between the two user groups could also increase. Under alternative A, PWC use would have negligible to minor adverse effects on visitors to park campgrounds and minor adverse effects at higher water levels when campgrounds are more accessible from the water.

There is one designated hiking trail along the northern shoreline of Blue Mesa Reservoir at Dillon Pinnacles. Roads and miles of undesignated hiking trails also provide access to much of the Blue Mesa shoreline. PWC use in areas such as these that are popular with both personal watercraft and other shoreline visitors could affect visitors seeking natural quiet. However, anglers who seek solitude can fish in Morrow Point and Crystal Reservoirs, and along the Gunnison River east of Beaver Creek – areas closed to motorized watercraft. In addition, many shoreline visitors are travelers stopping to enjoy the scenery and picnic, not necessarily to have a solitude experience, thus PWC use under alternative A would have a negligible to minor adverse effect on hikers and shoreline users.

PWC use would not result in a noticeable change in shoreline visitor experiences because the park provides flat-wake speed areas for non-PWC visitors to enjoy park activities. However, violations of flat-wake speed zones and the expected increase in PWC use at congested areas in the Blue Mesa Reservoir could result in negligible to minor adverse impacts on the experiences of these shoreline visitors.

Cumulative Impacts. The primary activities at Curecanti National Recreation Area that could affect visitor experiences include the number and activities of other visitors and noise from vehicles and motorboats. Increased use or expansion of U.S. 50 would cause an increase in noise levels and increased lakeshore activity. Due to low water levels, several boat launch ramps were unusable in 2002. Although the Bureau of Reclamation regulates lake levels, it is impossible to predict the effects of drought conditions and downstream water needs on future water levels. However, if drought conditions worsen,

boat ramps and swim beaches may become unusable, and usable launch areas could become more crowded. It is, however, impossible to predict future water levels. Predictable cumulative impacts related to the use of personal watercraft, motorized boats, and other visitor activities would be negligible to minor over the short and long term.

Conclusion. Reinstated PWC use would result in negligible to minor adverse impacts on experiences for most visitors in the short and long-term under alternative A. Swimmers and other motorized boat users would be most affected by PWC use because of the popularity of the day use areas habituated by PWC, especially at Dry Creek Picnic Area, Bay of Chickens, and the windsurfing beach. PWC use would have short- and long-term negligible to minor adverse impacts for visitors who desire a more passive recreational experience and desire natural quiet. Overall, most visitors to Curecanti National Recreation Area would experience negligible to minor adverse effects under this alternative and would be satisfied with their experiences at Curecanti National Recreation Area.

Cumulative effects of PWC use, other watercraft, and other visitors would result in short and long-term, negligible to minor adverse impacts.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. PWC use would be reinstated as under alternative A, with additional management prescriptions. PWC operators would be required to operate at flat-wake speed 100 feet from the south shoreline of Blue Mesa Reservoir from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge, and an additional 100-foot buffer zone would be established on the northern shore of the main body at Stevens Creek to protect Gunnison sage grouse habitat. In addition to the speed restriction zones described in alternative A, speed and proximity zones would be created from the mouth of the lake arms upriver to the point where noise or speed impact visitor safety, wildlife, or soundscapes, and a flat-wake speed zone would be established from this point upriver to river inlet. A voluntary PWC user education program would be established.

Impact on PWC Users — Prohibiting PWC from using the north or south shores of Blue Mesa Reservoir within the proposed buffer zone would likely result in a negligible adverse impact on most PWC users, as this is not a high PWC use area, and miles of shoreline would still be accessible. The change in zoning of the lake arms would have a minor to moderate adverse impact on PWC users, as these calmer, narrow areas of the reservoir would not be available for any high speed use. However, this zoning change would likely have a moderate adverse impact on PWC users who traditionally had less restrictive access to the lake arms, and a negligible adverse impact on PWC users new to the reservoir. The voluntary education program for PWC users would likely have beneficial impact on PWC users, as their safety and the safety of other visitors and their understanding of visitor uses and experience issues would be improved. Overall, alternative B would have a minor to moderate adverse impact and a negligible to minor adverse impact on PWC users at Blue Mesa Reservoir.

Impact on Other Boaters — As under alternative A, other boaters at Curecanti National Recreation Area would interact with PWC operators and experience impacts similar to alternative A. The 100-foot buffer zone along the south shore would benefit canoeists and kayakers who travel along the shoreline because PWC would operate at flat-wake speed. The south shoreline has not historically been a high-use area for PWC, so the shoreline speed restrictions would not cause a noticeable increase in PWC landings along other sections of shoreline. Restricting speed in the lake arms could have a negligible to minor adverse impact on other non-motorized and motorized boaters using the main body of the reservoir, as this action would force PWC to recreate in the main body of the reservoir adding to congestion. Non-motorized and

motorized vessels using the lake arms to seek quiet waters would see a beneficial impact on their experience, as PWC would be moving more slowly and quietly around them in these locations. The proposed management prescription could cause PWC users to recreate in other reservoirs and lakes, which would result in a beneficial impact on the experience of other boaters at Blue Mesa Reservoir, as the reservoir would be less crowded. The zoning at the windsurfing beach would not change under this alternative, so impacts would be similar to alternative A. Boaters in launch areas would experience impacts similar to alternative A. Overall, impacts on other boaters seeking quiet waters would be beneficial, and for other boaters impacts would be negligible to minor adverse.

Impact on Other Visitors — Campers**,** swimmers, anglers, hikers, and other shoreline visitors to the reservoir would have contact with PWC users. High-use shoreline areas that are popular with both PWC and other shoreline users such as the picnic areas in the vicinity of Dry Creek, the Soap Creek Arm, Bay of Chickens, and off Highway 149 just south of the Lake City Bridge would experience impacts similar to alternative A, as zoning in these areas would not change. Shoreline users in the lake arms would experience less noise and speed from PWC, so impact to these users would be beneficial, but shoreline users on the main body of the reservoir could experience higher PWC use, and thus a negligible to minor adverse impact on their experience. Zoning around shoreline campgrounds would not change, so impacts to campground users would be the same as in alternative A. Backcountry hikers and campers using the south shoreline would experience a beneficial impact to their experience, as PWC noise would be reduced in this area due to the buffer. Hikers on the Dillon Pinnacles trail would have similar impacts as alternative A. Shoreline hiking would become quieter in the lake arms, causing a beneficial impact on this visitor experience, and shoreline hiking on the main body of the reservoir would experience impacts similar to alternative A. Shoreline angling would experience the same impacts as hiking – use in the lake arms and on the south shore would be less noisy and have less traffic, and the main body shoreline anglers could see a slight increase in PWC activity, so a possible negligible to minor impact on their experience. The impact of a voluntary education program would most likely have a beneficial impact on all users.

Cumulative Impacts. Cumulative impacts would be the same as alternative A except the impacts on backcountry visitor experience along the south shore where PWC closure is proposed would be negligible to minor due to the presence of other motorized vessels along the shoreline. Cumulative impacts related to the use of personal watercraft, motorized boats, and other visitor activities would be negligible to minor over the short and long term.

Conclusion. PWC management strategies such as shoreline zoning would have negligible to minor adverse impact on most PWC users, because most of the more popular PWC use locations at the park would remain available for use. Some PWC users would experience short term minor to moderate adverse impacts due to speed restriction in the lake arms, but overall PWC users would experience a long term negligible to minor adverse impact due to buffers and wake restrictions. Shoreline users, those seeking more natural surroundings, and non-motorized and motorized boaters using the lake arms would experience beneficial impacts and visitors using the main body would experience negligible to minor adverse impacts.

Cumulative effects of PWC use, other watercraft, and other visitors would result in short and long-term, negligible to minor adverse impacts.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Personal watercraft would be eliminated from Blue Mesa Reservoir and these visitors would no longer be allowed to participate in this form of recreation in the national recreation area. PWC are estimated to comprise 7% of all vessels on the reservoir on peak use days, which represents a small

percentage of visitors. Based on current use projections and an average 1.5 users per PWC, in 2012 approximately 30 PWC riders would not be able to enjoy this experience in the national recreation area on a typical holiday weekend. This number constitutes a very small percentage of daily peak visitation, and would not preclude the park from its goal of offering a wide range of recreational activities.

Impact to PWC Users — Banning PWC use would have a moderate to major impact on PWC users who are local residents, because there are not any lakes of this size in the vicinity. Glen Canyon National Recreation Area is 420 miles from Gunnison and Lake Mead is 650 miles from Gunnison. However, discontinuing PWC use would not necessarily preclude a visit to the recreation area by PWC owners. Nationally, approximately 68% of PWC owners previously owned powerboats (NTSB 1998). Current PWC users could still use a motorboat or other watercraft and could continue to experience activities such as hiking, sightseeing, and camping. The level of impact to PWC users would be moderate to major adverse.

Impact to Other Boaters — Banning PWC use within Curecanti would eliminate interactions between other boaters and PWC operators. Few incidents have been documented involving a PWC user and other vessels since 1995, but it is assumed that this alternative would eliminate any possible conflicts, particularly since PWC use is expected to continue to increase if PWC use is reinstated. Other boaters would not have to watch for or come into conflict with PWC users, especially in the heavily congested launch areas, thus resulting in beneficial impact on other watercraft users.

Impact to Other Visitors — Restricting PWC use within the national recreation area would have a beneficial effect on other shoreline users, especially swimmers and anglers. Campers, shoreline hikers, and anglers would experience more natural quiet in the traditional high PWC use areas, but would still be exposed to sounds from other motorized watercraft.

Cumulative Impacts. The primary activities at Curecanti that may affect visitor experiences include the number and activities of other visitors and noise from vehicles and motorboats. The cumulative impacts would be related to a possible increase in other types of motorboats in response to a ban of PWC. The impacts on backcountry visitor experience along the south shore where PWC closure is proposed would be negligible to minor due to the presence of other motorized vessels along the shoreline. On a regional basis the no-action alternative would result in a negligible adverse effect to PWC activities on other water bodies in the region as a result of PWC users going to other locations to enjoy this activity.

Conclusion. The no-action alternative would have a beneficial impact on the experiences of most non-PWC using visitors due to the ban of PWC. Impacts on PWC users, particularly local residents, who would no longer be able to ride in the national recreation area would be short and long term, moderate to major, and adverse.

VISITOR CONFLICTS AND SAFETY

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year, PWC operators accounted for more than 41% of people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998). Since PWC operators can be as young as 12 in several states, accidents can involve children. The American Academy of Pediatrics (2000) recommends that no one younger than 16 operate personal watercraft.

No PWC accidents have been documented at Curecanti from 1995 to 2001. Staff do not commonly receive calls for assistance in locating a PWC operator who is overdue or "missing". Rangers receive few complaints from other visitors regarding PWC users. Boat patrols are conducted on a regularly scheduled basis during the summer season on high use days.

PWC speeds, wakes, and operations near other users can pose hazards and conflicts. The park has noted conflicts between PWC and anglers. PWC have also come into conflict with swimmers by not slowing down as required in the presence of swimmers. However, the park has not received many complaints about PWC from other visitors. Diving at Curecanti National Recreation Area is permitted but not common.

GUIDING REGULATIONS AND POLICIES

In addition to the guiding regulations and policies discussed in the "Visitor Experience" section, the NPS *Management Policies 2001* state that the agency is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. The policies also state, "While recognizing that there are limitations on its capacity to totally eliminate all hazards, the Service and its concessioners, contractors and cooperators will seek to provide a safe and healthful environment for visitors and employees" (Section 8.2.5.1) Further, the National Park Service will strive to protect human life and provide for injury-free visits (Section 8.2.5).

Director's Order #9: Law Enforcement Program (NPS 2000a), in conjunction with *Reference Manual 9: Law Enforcement,* establishes and defines standards and procedures for NPS law enforcement. Along with education and resource management, law enforcement is an important tool in achieving this mission. Commissioned rangers perform resource stewardship, education, and visitor use management activities, including law enforcement. They provide for tranquil, sustainable use and enjoyment of park resources while simultaneously protecting these resources from all forms of degradation. The objectives of the law enforcement program are to (1) prevent criminal activities through resource education, public safety efforts, and deterrence, (2) detect and investigate criminal activity, and (3) apprehend and successfully prosecute criminal violators.

PWC regulations have been established by the state of Colorado to keep the waterways safe and enjoyable.

- Operation of a PWC from one-half hour after sunset to one-half hour before sunrise is prohibited.
- Operators and passengers of personal watercraft must wear a U.S. Coast Guard-approved personal flotation device (PFD) of the appropriate size.
- Emergency engine shut-off lanyards must be used if the vessel is equipped with them.
- A two-person PWC can be used for water-skiing if there is an operator, an observer and the skier.
- Do not operate your PWC carelessly and recklessly by becoming airborne while crossing the wake of another vessel at an unsafe distance, unsafely weaving through traffic, or operating at such a speed and proximity to another vessel that the operator of either vessel must swerve or abruptly cut speed in order to avoid a collision.

- Operators must be at least 16 years old to operate all motorboats, including personal watercraft. Fourteen and 15 years old may operate a PWC if they complete a boating safety course accepted by Colorado State Parks.

- Reduced speed within 150 feet of swimming areas, moored vessels, and people fishing on the shoreline.

- Maximum speed of 40 mph except during a race.

METHODOLOGY AND ASSUMPTIONS

The methodology for visitor conflicts and safety is similar to that used for visitor experience. The potential visitor-related impacts attributable to personal watercraft — a higher rate of accidents than for other watercraft, conflicts with other park users, negative effects on some types of visitor experiences — could potentially affect the mandate to provide for injury-free visits. Potential impacts were identified based on the number and activities of personal watercraft operating within the area, the number and activities of other visitors in an area, and the proximity of these user groups.

It is assumed that Colorado PWC regulations are enforced within the national recreation area. These regulations govern PWC activities near the shore, the timing of use, and the age and educational requirements of operators.

IMPACT ANALYSIS AREA

In terms of PWC use, the impact area was defined as all areas of Curecanti that are open to PWC as described in the *Superintendent's Compendium* (NPS 2002g). This includes the body of Blue Mesa Reservoir from 500 feet above the Blue Mesa Dam upstream to the Lake City Bridge. Additionally, PWC use may affect visitors at beaches, trails, and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PWC USE AND CONFLICTING USES ON VISITOR SAFETY

The impact intensities for both visitor conflicts and safety follow. Where impacts to visitor experience or visitor safety become moderate or minor, it is assumed that current visitor satisfaction and safety levels would begin to decline and the park would not be achieving some of its long-term visitor goals.

Negligible: The impact to visitor safety would not be measurable or perceptible.

Minor: The impact would be measurable or perceptible, and it would be limited to a relatively small number of visitors at localized areas. Impacts to visitor safety could be realized through a minor increase or decrease in the potential for visitor conflicts in current accident areas.

Moderate: The impact to visitor safety would be sufficient to cause a permanent change in accident rates at existing low accident locations or to create the potential for additional visitor conflicts in areas that currently do not exhibit noticeable visitor conflict trends.

Major: The impact to visitor safety would be substantial either through the elimination of potential hazards or the creation of new areas with a high potential for serious accidents or hazards.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC operators under alternative A would have unrestricted use along the Blue Mesa Reservoir shoreline within the impact analysis area, with use increasing from 9 personal watercraft per typical summer season day to 11 PWC per day by 2012. Peak use days would see an increase from 16 to 20 PWC per day, based on an increase of 2% per year.

Personal Watercraft/Swimmer Conflicts — The greatest potential for conflict with swimmers is at the high use areas near Dry Creek Picnic Area, Bay of Chickens windsurfing beach area, and along Highway 149 just south of the Lake City Bridge. This is where many of the park's visitors swim, and these areas include the most PWC areas within the national recreation area. No PWC-related accidents have been documented since 1995. However, when PWC operators fall or are thrown from their PWC, the machine can continue running and documented cases describe unmanned PWC harming swimmers in Michigan and Florida (NTSB 1998).

The park has established flat-wake speed zones to help protect visitors, but violations do occur in these areas, and historically, PWC operators are more likely to infringe on the flat-wake speed rule than other vessel operators. An estimated 16–20 personal watercraft would be operated in the reservoir during peak use days, many of which would likely concentrate near popular swim areas and may violate the flat-wake speed rule to beach, pick up passengers, or change operators. Even though no PWC related accidents have occurred involving a swimmer, the park has received complaints from swimmers about PWC not slowing down as required in the presence of swimmers. PWC users may operate at speeds of up to 40 mph on the reservoir, and the potential exists for an accident involving a swimmer. Due to the concentration of visitors that use these areas, impacts regarding swimmer safety at these locations are predicted to be minor to moderate adverse.

The remaining park locations would experience little or no conflict between PWC users and swimmers. There are few swimmers in other areas of the park that are frequented by PWC. Thus, conflicts in these segments would constitute negligible adverse impacts. Swimming is not a popular activity at Curecanti due to cold water. Swimmers tend to be in the water for short periods of time and tend to stay close to shore.

Personal Watercraft/Other Boat Conflicts — PWC represent an estimated 7% of all vessels at Blue Mesa Reservoir on peak use days. At Curecanti, no vessel accidents (out of 24 accidents from 1995 through 2000) involved PWC. Potential for incidents or accidents at congested boat ramps exists but the impact of PWC use on safety would be considered negligible to minor. PWC may come into conflict with non-motorized boats in the flat-wake speed areas, where PWC have violated the flat-wake speed rules. Impacts to other boaters are predicted to be negligible to minor adverse.

Overall, PWC use would have negligible to minor adverse impacts on other boat users at Curecanti National Recreation Area. Impacts would be concentrated primarily at the boat launches and high PWC use areas.

Personal Watercraft/Other Visitor Conflicts — Blue Mesa Reservoir and its shoreline are used by a variety of visitors, including swimmers, motorboat users, kayakers, canoeists, campers, anglers, and hikers. All of these user groups interact with each other and occasionally come into conflict. Some user

groups are more distributed than others. For example, kayakers, canoeists, and swimmers tend to stay close to the shore, whereas PWC and motorboat operators tend to operate at least 150 feet offshore, unless landing and taking off. This separation of use reduces the potential for conflicts between the various groups. However, several of these user groups favor the same general location.

Cumulative Impacts. The cumulative impact of the various user groups on visitor conflicts and safety under alternative A would be negligible to minor adverse over the short and long term.

Conclusion. Reinstated PWC use would have short-term negligible to minor adverse and long-term, minor adverse impacts on visitor conflicts and safety, particularly in the noted high PWC use locations due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts at other locations would remain negligible adverse because use is lower and conflicts would be less likely to occur.

Cumulative impacts related to visitor conflicts and safety would be minor adverse for all user groups in the short and long term, particularly near the high-use areas. Cumulative impacts in other areas of the reservoir would be negligible adverse.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. PWC use would be reinstated as under alternative A, with additional management prescriptions, with use increasing from 9 personal watercraft per typical summer season day to 11 PWC per day by 2012. Peak use days would see an increase from 16 to 20 PWC per day, based on an increase of 2% per year. Under alternative B, PWC operators would operate at flat-wake speeds 100 feet from the south shoreline of Blue Mesa Reservoir from 0.5 mile west of Iola to 0.5 mile east of Middle Bridge. In addition to the speed restriction zones described in alternative A, speed and proximity zones would be created from the mouth of the lake arms upriver to the point where noise or speed impact visitor safety, wildlife, or soundscapes, and a flat-wake speed zone would be established from this point upriver to river inlet. A voluntary PWC user education program would be established.

Personal Watercraft/Swimmer Conflicts — PWC and swimmers would interact under alternative B. Restricting PWC speeds in the popular lake arms could result in PWC operators using other areas of the reservoir to recreate at the higher speeds, potentially causing an increase in conflict at current high use areas. Although state regulations require reduced speed within 150 feet of swimmers, violations and an expected increase in PWC use at congested locations, particularly the boat launches near popular swim areas, could affect swimmers in the long term. Although the proposed speed zoning is for areas of the reservoir that are not particularly high swim use areas, swimmers in the lake arms or along the south shoreline would experience a slight benefit from PWC operators having speed restrictions in the lake arms. The voluntary PWC user education program could result in reduced conflicts between PWC and other visitors. As under alternative A, swimmers at Curecanti could experience minor adverse impacts.

Personal Watercraft/Other Boat Conflicts — Impacts would be similar to alternative A. As mentioned above, speed restrictions in the lake arms could force PWC users into other areas of the reservoir, increasing the potential for conflict in other areas. However, non-motorized boaters, and those boaters seeking the calmer waters of the new speed-zoned areas would have a reduced potential for conflict and see a beneficial impact on visitor safety and conflict.

Overall, PWC use would have a minor adverse impact on conflicts and safety of boat users concentrated at localized areas and boat launches, and a beneficial impact on conflict and safety on boaters in the lake arms.

Personal Watercraft/Other Visitor Conflicts — The primary activities at Curecanti National Recreation Area that may affect visitor conflict and safety include the number and activities of other visitors. If lake levels continue to recede, boat ramps and swim beaches may become unusable, causing available locations to become more crowded and possibly experience an increase in conflict and reduction in safety, especially due to areas restricted by speed.

Cumulative Impacts. Under alternative B, cumulative impacts of PWC use, other watercraft, and other visitors on conflict and safety would be negligible to minor adverse over the short and long term at high use areas, and cumulative impacts on conflict and safety in the lake arms would be beneficial.

Conclusion. Reinstated PWC use with the management prescriptions of alternative B would have short- and long-term, minor to moderate adverse impacts on visitor conflicts and safety in the high use areas and boat launches due to the number of visitors and boats present on high use days, as well as a concentration of conflicting uses. Conflicts at lake-arm locations would be negligible to minor adverse because PWC speed would be zoned and conflicts would be less likely to occur.

Cumulative impacts related to visitor conflicts and safety would be minor to moderate adverse for all user groups in the short and long term, particularly near the high-use areas. Cumulative impacts in lake arms would be negligible adverse because of reduced use.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Under the no-action alternative all PWC use would be banned, eliminating any conflicts between PWC operators and other recreation area visitors. PWC have been involved in no vessel accidents, and 9 violations since 1998. Eliminating PWC operation in the national recreation area would yield a perceptible change for some visitors, particularly swimmers. No incidents would occur between swimmers or boaters and personal watercraft, resulting in a beneficial impact.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A, except PWC use would be eliminated. Overall, conflicts and safety would improve as compared to alternative A and B because eliminating PWC use within the national recreation area would remove the potential for conflicts between PWC users, as well as between PWC users and swimmers or other boaters. Conflicts between motorboat users and other non-motorized craft in would occur. Cumulative impacts to visitor conflict and safety would be reduced to negligible.

Conclusion. Discontinuing PWC use would result in short- and long-term, beneficial impacts by reducing visitor conflicts and enhancing safety. PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be beneficial.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

NPS's primary interest in these places stems from its responsibilities under the following legislation:

The NPS Organic Act — responsibility to conserve the natural and historic objects within parks unimpaired for the enjoyment of future generations

National Historic Preservation Act — responsibility to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage

American Indian Religious Freedom Act — responsibility to protect and preserve for American Indians access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites

Archeological Resources Protection Act — responsibility to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public lands

Executive Order 13007 — responsibility to (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites.

In accordance the *Management Policies 2001*, the National Park Service must be respectful of these ethnographic resources, and carefully consider the effects that NPS actions may have on them (*Management Policies 2001,* sec. 5.3.5.3).

METHODOLOGY AND ASSUMPTIONS

In this environmental assessment impacts to cultural resources (archeological resources, historic structures, the cultural landscape, and ethnographic resources are described in terms of type, context, duration, and intensity, which is consistent with the CEQ regulations. These impact analyses are intended, however, to comply with the requirements of both the *National Environmental Policy Act* and Section 106 of the *National Historic Preservation Act* (NHPA). In accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 (36 CFR 800, "Protection of Historic Properties"), impacts to cultural resources were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that were either listed on or eligible to be listed on the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed on the national register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the advisory council's regulations a determination of either *adverse effect* or *no adverse effect* must also be made for affected, national register eligible cultural resources. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualify it for inclusion on the national register (e.g., diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5, "Assessment of Adverse Effects"). A determination of *no adverse effect* means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion on the national register.

CEQ regulations and DO #12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in intensity

of impact due to mitigation, however, is an estimate of the effectiveness of mitigation only under the *National Environmental Policy Act*. It does not suggest that the level of effect as defined by Section 106 is similarly reduced. Although adverse effects under Section 106 may be mitigated, the effect remains adverse.

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Archeological resources have the potential to answer, in whole or in part, such research questions. An archeological site(s) can be eligible to be listed on the National Register of Historic Places if the site(s) has yielded, or may be likely to yield, information important in prehistory or history. An archeological site(s) can be nominated to the national register in one of three historic contexts or levels of significance: local, state, or national (see National Register Bulletin #15, *How to Apply the National Register Criteria for Evaluation*). For purposes of analyzing impacts to archeological resources, thresholds of change for the intensity of an impact are based upon the potential of the site(s) to yield information important in prehistory or history, as well as the probable historic context of the affected site(s):

Negligible: The impact is at the lowest level of detection or barely measurable, with no perceptible consequences, either adverse or beneficial, to archeological resources. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Minor: Adverse Impact — The impact would affect an archeological site with the potential to yield information important in prehistory or history. The historic context of the affected site(s) would be local. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact — A site would be preserved in its natural state. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Moderate: Adverse Impact — The impact would affect an archeological site with the potential to yield information important in prehistory or history. The historic context of the affected site would be statewide. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact — The site would be stabilized. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Major: Adverse Impact — The impact would affect an archeological site with the potential to yield important information about human history or prehistory. The historic context of the affected site would be national. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact — Active intervention would be taken to preserve the site. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of (park name); (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents. Project inventories and mitigation would still be conducted. However, without a systematic monitoring program and given the potential access concerns, there would continue to be a risk of some unavoidable adverse impacts.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. PWC users would have access to archeological resources under this alternative. In 1985, a National Register of Historic Places nomination was prepared for the Curecanti Archeological District. The nomination has been amended to include eligible resources documented since 1985.

Potential impacts directly attributable to unrestricted PWC use are difficult to quantify. The most likely impact to archeological sites would result from PWC users landing in areas otherwise inaccessible to most other national recreation area visitors and illegally collecting or damaging artifacts. According to park staff, looting and vandalism of cultural resources is not a substantial problem. A direct correlation of impacts attributed to PWC users is difficult to draw, since many of these areas are also accessible to backcountry hikers or other watercraft users. Under this alternative the low number of PWC users within the national recreation area would have only minor adverse impacts on listed or potentially listed archeological resources.

Continuing PWC use under a special regulation is not expected to negatively affect the overall condition of cultural resources because project-by-project inventories and mitigation would still be conducted. However, without a systematic monitoring program and given the potential access concerns, there would be a risk of some unavoidable adverse impacts.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would have access to remote areas with potentially listed archeological sites. On a cumulative basis all visitor activities could result in minor to major adverse impacts on those resources that are readily accessible, due to the number of visitors and potential for looting or vandalism. Resources in more remote areas that are not as readily accessible to visitors would likely still experience minor adverse impacts on a cumulative basis, but to a lesser degree. All impacts levels would continue at existing levels.

Conclusion. PWC use within the national recreational area could have minor adverse impacts on listed or potentially listed archeological sites from possible illegal collection and vandalism.

Cumulative impacts on archeological resources that are readily accessible could be minor to major adverse, due to the number of visitors and the potential for illegal collection or destruction.

Implementation of this alternative would not result in an impairment of cultural resources.

Impacts of Alternative B: Reinstate PWC Use
under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. PWC users would have access to archeological resources under this alternative.

Impacts to archeological resources would be similar to those under alternative A. Under this alternative the low number of PWC users within the park would have only minor adverse impacts on listed or potentially listed archeological. Creation or extension of flat-wake speed zones and speed restrictions in the arms and into main body areas would reduce wave action and could have a long-term beneficial impact on listed or potentially listed archeological sites.

Cumulative Impacts. On a cumulative basis all visitor activities could result in minor to major adverse impacts on those resources that are readily accessible, due to the number of visitors and the potential for looting or vandalism. All impact levels would continue at existing levels, with lower impacts in areas with flat-wake speed zones or speed restrictions in the arms and into main body areas.

Conclusion. Modification of flat-wake speed zones and speed restrictions from arm areas into main body areas could have minor adverse impacts on listed or potentially listed archeological resources from possible illegal collection and vandalism. There would also be a beneficial impact on those resources from the reduced erosion resulting from lower speeds.

Cumulative impacts of other activities on archeological resources that are readily accessible could be minor to major and adverse, due to the number of visitors and the potential for illegal collection or destruction.

Implementation of this alternative would not result in an impairment of cultural resources.

Impacts of the No-Action Alternative: Allow No PWC Use

Analysis. Under this alternative PWC use would not be reinstated.

Implementation of the no-action alternative would result in beneficial impacts on archeological sites by reducing the potential for illegal collection or damage attributable to PWC users.

Cumulative Impacts. Even without the potential for PWC users to access remote areas, the effects of other watercraft users and land-based user groups would still have the potential for minor to major adverse cumulative impacts. On a cumulative basis potential visitor impacts from illegally collecting or damaging resources that are readily accessible would continue. Resources in more remote areas that are not as readily accessible to park visitors would likely still experience minor adverse impacts, but to a much less degree.

Conclusion. Prohibiting PWC use would have beneficial impacts on archeological sites.

Cumulative impacts from all other visitor activities would be minor to major, depending on the accessibility of the resource and the potential for illegal collection or damage, by non-PWC users.

Implementation of this alternative would not result in an impairment of cultural resources.

SECTION 106 SUMMARY

This environmental assessment provides detailed descriptions of three alternatives (including a no-action alternative) and analyzes the potential impacts associated with possible implementation of each alternative. The analysis of potential impacts of personal watercraft at Curecanti National Recreation Area also considered access by other types of watercraft.

Visitors access areas of the recreation area by many transport modes, including motor vehicles, in boats of all types, by hiking, and by personal watercraft. Because of this diversity of modes of access, the impacts on archeological and historic cultural resources directly attributable solely to personal watercraft users are difficult to define. Effects can best be defined in the upper canyons or arms where access is limited by area topography to shallow-depth watercraft like personal watercraft and non-motorized vessels such as canoes or kayaks. Under alternatives A and B, in these upper canyon or arm areas, negligible to minor benefits to archeological resources could result from reductions in the number of personal watercraft accessing the area. This would constitute a "*no adverse effect*" on archeological resources.

Reduced wake zones in alternatives A and B would slow damage to a few vulnerable archeological resources that are partially submerged, or that are located along the beaches and canyon walls. However,

because of their small size and amount of water displacement, wakes from personal watercraft would make up an extremely small part of the reservoir wave action. Thus, beneficial impacts of reduced wake zones outlined in alternatives A and B would be negligible, resulting in "*no adverse effects*" from this source under this alternative.

Continuation of traditional religious activities is crucial to preservation of tribal cultural values and identity. Visitors using personal watercraft, as well as other means of transport, can deliberately or unknowingly intrude on ceremonial activities or disturb resources and archeological sites valued by tribes. Under alternative B, personal watercraft use would be eliminated in the upper arms. Most of this use would transfer to more developed areas containing fewer ethnographic resources. Closure of the area would help reduce noise and other intrusions on ethnographic resources. Other types of watercraft such as rafts and canoes could still access these areas and intrude on traditional practices, resulting in negligible to minor adverse impacts (*no adverse effects*).

Under alternative B, fewer personal watercraft users would be present in some areas, resulting in minor benefits (*no adverse effect*) on ethnographic landscapes. Impacts on historic resources and cultural landscapes would be likely to continue at negligible to moderate levels (*no adverse effect*).

To help reduce impacts on cultural resources, resources would continue to be monitored on a regular basis. Vulnerable resources listed on or potentially eligible for the National Register of Historic Places would have priority for protective measures, and the recreation area staff would continue to actively work with tribes to protect ethnographic resources and privacy for traditional activities. During periods of drawdown and potential exposure of vulnerable submerged archeological resources, appropriate management actions would be implemented. These could include such actions as monitoring, site stabilization, and visitor management actions such as signing, ranger patrols, or interpretive messages.

In cases where it was determined there was a potential for adverse impacts (as defined in 36 *Code of Federal Regulations* 800) to cultural resources listed on or eligible for listing on the National Register of Historic Places, the National Park Service would coordinate with the state historic preservation officer of Colorado to determine the level of effect on the property, and to determine what mitigation would be needed.

Curecanti National Recreation Area staff would continue to educate visitors regarding archeological and ethnographic site etiquette to provide long-term protection for surface artifacts, architectural features, and traditional activities. If necessary, additional mitigation measures would be developed in consultation with the state historic preservation officer and concerned Native American tribes.

Concerned Native American tribes will receive copies of this environmental assessment for review and comment. This environmental assessment will also be sent to the Colorado state historic preservation officers and to the Advisory Council on Historic Preservation for review and comment as part of the Section 106 compliance process.

Pursuant to 36 CFR 800.5, implementing regulations of the *National Historic Preservation Act* (revised regulations effective January 2001), addressing the criteria of effect and adverse effect, the National Park Service finds that the implementation of the plan in Curecanti National Recreation Area, with identified mitigation measures, would be beneficial, and would not result in any new adverse effects (*no adverse effect*) to archeological, historic, ethnographic, or cultural landscape resources currently identified as eligible for or listed on the National Register of Historic Places.

SOCIOECONOMIC EFFECTS

The socioeconomic effects of implementing PWC regulations at Curecanti National Recreation Area were provided in the report "Economic Analysis of Personal Watercraft Regulations in Curecanti National Recreation Area." (LAW 2002). The following briefly summarizes those effects.

BENEFIT-COST ANALYSIS

The purpose of benefit-cost analysis is to determine whether a proposed action (in this case, the regulation of PWC use in Curecanti National Recreation Area) would promote an efficient allocation of resources. That is, whether the proposed action would generate more benefits than costs. These costs and benefits accrue directly to households that use personal watercraft, and indirectly to those who are affected by PWC use (e.g., those who benefit from reduced noise). The resulting changes in PWC use may also impose costs on those who own or work for PWC-related businesses. For the purpose of this study, six major affected groups were identified (LAW 2002) as listed in table 28. The following definitions apply:

> *Consumer surplus* — the economic measure of net benefits that accrue to individuals from PWC use and the appreciation of park resources.
>
> *Producer surplus* — the economic measure of net benefits that accrue to businesses that sell or rent personal watercraft and other related businesses. Producer surplus is generally equivalent to business profit.

Increases in consumer surplus and producer surplus represent benefits, while decreases in those measurements represent costs. The impacts by user groups are also identified in table 28.

COSTS TO PWC USERS

Two groups of PWC users might be affected by the proposed restrictions: PWC users who currently ride in Curecanti National Recreation Area and those who ride in other areas outside the national recreation area. Users displaced from the national recreation area could decide to ride in these other areas if PWC use within NPS boundaries were restricted. For PWC users who currently ride in the national recreation waters or who may want to ride there in the future, use restrictions could result in consumer surplus losses. However, to the extant that individuals consider other PWC areas close substitutes to riding in the national recreation area, the loss in consumer surplus associated with restricting PWC use in the national recreation area would be lower. PWC users in nearby areas could lose some consumer surplus if these areas become more crowded due to PWC restrictions within the national recreation area.

Under alternative A no change in PWC use is anticipated. Consumer surplus to PWC users would remain unchanged from current conditions. Under alternative B, consumer surplus losses would be minimal. Under the no-action alternative banning PWC use would mean the PWC riders in the national recreation area would lose the full value of their consumer surplus for rides within national recreation area boundaries, but not in nearby substitute areas.

COSTS TO LOCAL AREA BUSINESSES

If PWC use decreased as a result of the alternatives being considered, then the suppliers of PWC and rental services could be affected. There are no producer surplus losses expected under alternative A. The majority of the estimated producer surplus losses occur in PWC sales/service and PWC rental markets

TABLE 28: SOCIOECONOMIC IMPACT OF ALTERNATIVES ON USER GROUPS

User Group	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation and Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
PWC Users	No change in consumer surplus.	Consumer surplus is expected to decrease very slightly for both current users and those who may wish to visit in the future as a result of flat-wake speed and refueling restrictions.	Consumer surplus is expected to decrease substantially for both current users and those who may wish to visit in the future as a result of the ban on PWC use in the park.
Other Visitors or Potential Visitors (canoers, anglers, other boaters, swimmers, hikers and other visitors)	No change in consumer surplus.	Consumer surplus is expected to increase slightly for current users as a result of potential increased solitude, increased water quality, and decreased risk of accidents involving PWC. Consumer surplus is expected to increase for new visitors who would not have visited without PWC use restrictions.	Consumer surplus is expected to increase for current users because PWC use would be banned in the national recreation area. A possible exception is for houseboat and other boat owners that enjoy using PWC as part of their trips, who will lose consumer surplus. Consumer surplus is expected to increase for new visitors who would not have visited without a ban of PWC use.
Producers of PWC Services (PWC rental shops, PWC sales shops, other parts of the local economy providing services to PWC users)	No change in producer surplus.	Most producers of PWC services would not experience a substantial change in producer surplus.	The PWC rental shop is expected to experience a large decline in producer surplus. Producer surplus for PWC dealerships is expected to decrease as a result of a decline in sales and servicing of personal watercraft. Other parts of the local economy such as hotels, restaurants and gas stations located near the park will also experience a decrease in producer surplus.
Local Residents	No change in welfare.	Local residents who use PWC may experience a slight decline in welfare due to flat-wake speed and refueling restrictions on the use of PWC within the park. Local residents who do not use PWC may experience a slight increase in welfare as a result of a potential decline in noise, increased water quality and a decrease in the risk of accidents involving PWC.	Local residents who use PWC will experience a decline in welfare due to a ban of PWC within the park. Local residents who do not use PWC may experience an increase in welfare as a result of a decline in noise, increased water quality and a decrease in the risk of accidents involving PWC.
Producers of Services for Non-PWC Users	No change in producer surplus.	Small increase in producer surplus.	Producer surplus is expected to increase because restrictions on PWC use may result in an increase in demand for angling, canoeing and other activities resulting in more demand for the provision of services related to these activities.

User Group	Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed	Alternative B: Reinstate PWC Use under a Special Regulation and Additional Management Prescriptions (Preferred Alternative)	No-Action Alternative: Allow No PWC Use
General Public	No change in welfare.	May experience an increase in welfare as a result of enhanced nonuse values resulting from increased environmental quality, although the change in welfare is expected to be smaller than under alternative A.	May experience an increase in welfare as a result of enhanced nonuse values resulting from increased environmental quality.

under alternatives B and C. Alternative B would range from $150 to $1,170 for PWC sales/service and from $30 to $70 for PWC rentals. Under alternative C, producer surplus losses are estimated to range from $2,300 to $17,610 for PWC sales/service and $640 to $1,440 for PWC rentals (LAW 2002).

In addition, lodging establishments, restaurants, gas stations and other businesses that serve PWC users could experience a reduction in business. Overall losses are estimated to be $0 under alternative A, $180 to $1,310 under alternative B, and $3,100 to $20,810 under alternative C.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

CONFLICT WITH STATE AND LOCAL PWC ORDINANCES AND POLICIES

Some states and local governments have taken action, or are considering taking action, to limit, ban, and otherwise manage PWC use. While a national park system unit may be exempt from these local actions, consistency with state and local plans must be evaluated in accordance with the *National Environmental Policy Act*.

Impacts related to conflicts with state and local ordinances have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Colorado has passed the *Colorado Boating Safety Regulation Act*, under the authority and jurisdiction of the Colorado Department of Public Safety.

This act regulates all motor vessel use within the state of Colorado. The National Park Service has jurisdiction over the surface water within the Curecanti boundary. The one exception is Colorado State Parks, which may patrol on the water once over the course of a summer. There are no local regulations that affect PWC operations within the park. Consistency with state and local plans must be evaluated in accordance with the *National Environmental Policy Act*.

Impacts related to conflicts with state and local ordinances have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. Personal watercraft users at the national recreation area would be required to follow all applicable state regulations, as well as NPS regulations. Under this alternative NPS rangers would enforce all state regulations within the recreation area, and there would be no conflicts between park regulations

and other regulations. Impacts for alternative A would be negligible adverse since no conflicts with state regulations would occur.

Cumulative Impacts. Personal watercraft are not prohibited at any location under this alternative. Implementation of alternative A would not be in conflict with existing policies or state regulations. Cumulative impacts would be negligible adverse under this alternative since management of PWC use would not be in conflict with state or local regulations.

Conclusion. PWC regulations within the national recreation area would include NPS and state regulations. Reinstated PWC use under alternative A would not result in conflicts with state regulations. Therefore, impacts (including cumulative impacts) would be negligible adverse.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. PWC use under alternative B would be managed under current state regulations. The additional management prescriptions included as a part of this alternative (related to enforcement, monitoring and sampling, and education) are more restrictive than state PWC regulations, but they would not conflict with state provisions or jurisdiction. Therefore, impacts related to conflicts with federal, state, or local requirements or policies would be negligible adverse.

Cumulative Impacts. Implementation of alternative B would not be in conflict with existing regulations or policies. No conflicts with federal or state regulations or policies are anticipated from implementing the management prescriptions under this alternative. The prescriptions would apply only within the national recreation area's jurisdictional boundary. Impacts that are related to conflicts with federal or state requirements or policies would be negligible adverse.

Conclusion. PWC use restrictions under alternative B would not result in conflicts with state PWC regulations or policies. Management prescriptions would apply only within the recreation area's jurisdictional boundary. Impacts related to conflicts with federal or state requirements or policies would be negligible adverse.

Impacts of No-Action Alternative: Allow No PWC Use

Analysis. The no-action alternative would ban PWC use within the national recreation area. The National Park Service has the right to regulate the types of activities that take place under its jurisdiction. State boating regulations do not have provisions that forbid additional controls or bans on PWC use, thus the implementation of additional restrictions would not be in conflict with state regulations or policies. The no-action alternative would not be in conflict with federal or state regulations or polices, and conflicts would be negligible adverse.

Cumulative Impacts. There are currently no prohibited landing locations at Blue Mesa Reservoir. Other areas in the vicinity of the national recreation area are subject to state PWC regulations. Implementation of the no-action alternative would not be in conflict with state regulations or policies. Cumulative impacts relating to regulation conflicts are negligible adverse.

Conclusion. Discontinuing PWC use within the national recreation area would not result in conflict with state PWC regulations or policies. There are no local PWC regulations. Therefore, impacts related to such conflicts (including cumulative impacts) would be negligible adverse.

IMPACT TO PARK OPERATIONS FROM INCREASED ENFORCEMENT NEEDS

Impacts to park operations from increased enforcement needs have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Impacts of Alternative A: Reinstate PWC Use under a Special Regulation as Previously Managed

Analysis. Reinstating PWC use within the national recreation area would require education and enforcement by park staff. This could be completed using the existing boat patrols, with the anticipation that PWC users would sometimes operate illegally within the recreation area (such as violating flat-wake speed zones). To provide more control of PWC operations, one additional permanent ranger would be required, as well as equipment and boat patrol needs, such as fuel, oil, and maintenance supplies. In addition, funds would be required to print and distribute PWC-specific rules and safety information as part of the PWC education program described for this alternative.

Cumulative Impacts. Motorboat users, swimmers, PWC operators, sea kayakers and canoeists all use the reservoir shoreline. Park staff would continue to provide assistance to these user groups to resolve conflicts and ensure safety. Park operations and enforcement needs for these groups would be the same as for existing conditions, since the number of people and boats would not change under this alternative. Current staffing levels and boat patrol frequency are not adequate to enforce existing regulations. One additional permanent staff member and additional equipment and boat patrol supplies would be required to meet existing and future (2012) needs. The staffing requirements to implement the PWC restrictions would be adequate for handling cumulative impacts related to park operations.

Conclusion. This alternative would have moderate adverse impacts on park operations. More staff, funding, equipment, and educational material would be needed to regulate existing PWC as well as boating use.

Implementation of this alternative would not result in impairment to park operations.

Impacts of Alternative B: Reinstate PWC Use under a Special Regulation with Additional Management Prescriptions (Preferred Alternative)

Analysis. Reinstating PWC use within the recreation area with management prescriptions such as enforcement, monitoring and sampling, and education, would require increased education and enforcement actions by park staff. Enforcement actions would be required. To provide more control of PWC operations, the park would require the same additional resources as described under alternative A.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A. One additional permanent staff, equipment, and boat patrol supplies would be required to meet existing and future (2012) needs. Additional education material would also be required. The staffing requirements to implement the PWC restrictions would be adequate for handling cumulative impacts related to park operations.

Conclusion. Similar to alternative A, this alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be needed to ensure full compliance with PWC management prescriptions for additional monitoring included as a part of this alternative.

Implementation of this alternative would not result in impairment to park operations.

Impacts of No-Action Alternative: Allow No PWC Use

Analysis. Prohibiting PWC operation within the Curecanti National Recreation Area would eliminate potential conflicts between PWC recreationists and other user groups, but park staff would have to increase visitor education and enforcement. Signs and information programs would be provided at the existing launch areas to indicate PWC use restrictions. Enforcement actions to ensure that PWC use restrictions were not violated could be completed using the existing irregular boat patrols, with the anticipation that PWC users would sometimes operate illegally within the recreation area.

Cumulative Impacts. Cumulative impacts would be similar to alternative A. However, even with a ban on PWC use, the park does not expect a need for increased existing staff or equipment. Enforcement would be conducted with existing staff and boat patrols.

Conclusion. This alternative would have negligible adverse impacts on park operations. No additional staff, funding, or equipment would be needed to ensure compliance with the PWC ban and to regulate existing boating use, although staff may initially need to spend more time and effort educating visitors until they became fully aware of the PWC ban.

Implementation of this alternative would not result in impairment to park operations.

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are impacts that cannot be avoided and cannot be mitigated, and therefore would remain throughout the duration of the action. The following list describes potential adverse impacts related to the alternatives being considered:

- PWC use would cause pollutant emissions into lake water and air under alternatives A and B. These impacts would decrease in the long term due to the required improvements in engine emission technology.

LOSS IN LONG-TERM AVAILABILITY OR PRODUCTIVITY TO ACHIEVE SHORT-TERM GAIN

As noted above, some resources would be degraded to some extent through implementation of either alternatives A or B. The only resource with potential long-term loss would be Gunnison sage grouse habitat. The continuation of inadequate monitoring and inventorying of resource conditions combined with long-term unlimited visitor use, could reduce the relative availability of habitat area for future Gunnison sage grouse populations.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irretrievable commitments of resources are those that can be reversed, that is, the commitment of a renewable resource or the short-term commitment of any resource. These include the commitment of water quality and air quality by allowing all mobile sources desiring to do so, including personal watercraft, to continue using the national recreation area under alternatives A and B. The use of fossil fuels to power personal watercraft would be an irretrievable commitment of this resource; however, this use is minor.

CONSULTATION AND COORDINATION

Curecanti National Recreation Area held two public workshops as part of the environmental assessment public involvement process to receive input on the regulation of PWC. The first meeting was in Gunnison on November 13, 2002, with a total of ten people attending, the second was in Montrose on November 14, 2002, with one person attending.

The workshops were an open house format with an opening presentation to welcome participants, address the purpose of meeting, lawsuit, current project, NEPA process, Rulemaking, schedule, and an invitation to visit tables. Base maps were used to discuss alternatives and personnel from the Resource Stewardship and Science Division addressed any resource concerns. Sign-in sheets recorded names of attendees and public comments cards were available as handouts.

The majority of comments received focused on concerns that restrictions imposed on personal watercraft would affect other boating use and recreation. The majority of attendees were non-PWC users.

CONSULTATION WITH OTHER AGENCIES

In accordance with the *Endangered Species Act*, the U.S. Fish and Wildlife Service was consulted about the presence of threatened, endangered, and candidate species, as well as species of concern within the area of PWC use in Curecanti National Recreation Area. Their response is included in appendix B.

Park staff contacted the State Historic Preservation Office (SHPO) for the state of Colorado early in the planning process. The SHPO concluded that PWC would have little direct impact on cultural resources. In the event that PWC use increases to the point of requiring additional facilities, the SHPO recommended that compliance for each facility occur on a case-by-case basis.

REVIEWING AGENCIES FOR THE ENVIRONMENTAL ASSESSMENT

The list of agencies and organizations that will be sent a copy of this environmental assessment is pending from the park.

APPENDIX A: APPROACH TO EVALUATING SURFACE WATER QUALITY IMPACTS

Objective

Using simplifying assumptions, estimate the minimum (threshold) volume of water in a reservoir or lake below which concentrations of gasoline constituents from personal watercraft or outboards would be potentially toxic to aquatic organisms or humans. Using the estimated threshold volumes, and applying knowledge about the characteristics of the receiving waterbody and the chemical in question, estimate if any areas within the waterbody of interest may present unacceptable risks to human health or the environment.

Overall Approach

Following are the basic steps in evaluating the degree of impact a waterbody (or portion of a waterbody) would experience based on an exceedance of water quality standards / toxicity benchmarks for PWC- and outboard-related contaminants.

1. Determine concentrations of polycyclic aromatic hydrocarbons (PAH), benzene, and methyl tertiary-butyl ether (MTBE) in gasoline (convert from weight percent to mg/L, as needed) and PAH in exhaust. The half-life of benzene in water is 5 hours at 25°C (Verschuren 1983; EPA 2001).

2. Estimate loading of PAH, benzene, and MTBE for various appropriate PWC-hour levels of use for one day (mg/day)

3. Find/estimate ecotoxicological and human health toxicity benchmarks (risk-based concentrations) (micrograms [μg]/L) for PAH, benzene, and MTBE.

4. Divide the estimated loading for each constituent (μg) by a toxicity benchmark (μg/L) to determine the waterbody threshold volume (L) below which toxic effects may occur (convert liters to acre-feet).

Estimated hydrocarbon (HC) emissions from personal watercraft and outboards will be substantially reduced in the near future, based on regulations issued by the U.S. Environmental Protection Agency and the California Air Resources Board (CARB).

Assumptions and Constants

Several assumptions must be made in order to estimate waterbody threshold volumes for each HC evaluated. Each park should have park-specific information that can be used to modify these assumptions or to qualitatively assess impacts in light of park-specific conditions of mixing, stratification, etc. and the characteristics of the chemicals themselves. The assumptions are as follows:

- BTEX (benzene, toluene, ethyl benzene, and xylene) are volatile and do not stay in the water column for long periods of time. Because benzene is a recognized human carcinogen, it is retained for the example calculations below and should be considered in each environmental assessment or environmental impact statement (Verschuren 1983; EPA 2001).

- MTBE volatilizes slightly and is soluble in water. MTBE may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.

- PAH volatilize slightly (depending on structure and molecule size) and may adhere to sediment and settle out of the water column or float to the surface and be photo-oxidized. They may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.

- The toxicity of several PAH increases (by several orders of magnitude) when the PAH are exposed to sunlight. This was not incorporated because site-specific water transparency is not known, and should be discussed qualitatively.

- The threshold volume of water will mix vertically and aerially with contiguous waters to some extent, but the amount of this mixing will vary from park to park and location to location in the lake, reservoir, river, or other waterbody. Therefore, although the threshold volume calculation assumes no mixing with waters outside the "boundary" of the threshold volume of water, this should be discussed in the assessment after the threshold volume is calculated. The presence or absence of a thermocline should also be addressed.

- Volume of the waterbody, or portion thereof, is estimated by the area multiplied times the average depth.

In addition to these assumptions, several constants required to make the calculations were compiled from literature and agency announcements. Gasoline concentrations are provided for benzene, MTBE and those PAH for which concentrations were available in the literature. Constants used are:

- Gasoline emission rate for two-stroke personal watercraft: 3 gal/hour at full throttle (CARB 1998)

- Gasoline emission rate for two-stroke outboards: estimated at approximately the same as for personal watercraft for same or higher horsepower outboards (80–150 hp); approximately twice that of personal watercraft for small (e.g., 15 hp) outboards. (Note: Assume total hours of use for the various size boats/motors, and that smaller 15 hp motors that exhaust relatively more unburned fuel would probably be in use for a much smaller amount of time than the recreational speedboats and PWC). This estimate is based on data from Allen et al. 1998 (Figure 5). It is noted that other studies may indicate different relative emission rates (e.g., about the same emissions regardless of horsepower, or larger horsepower engines having higher emission rates than smaller engines [CARB 2001]). The approach selected represents only one reasonable estimate.

- 1 gallon = 3.78 liters

- Specific gravity of gasoline: 739 g/L

- 1 acre-foot = 1.234×10^6 L

- Concentration of benzo(a)pyrene (B[a]P) in gasoline: up to 2.8 mg/kg (or 2.07 mg/L) (Gustafson et al. 1997)

- Concentration of naphthalene in gasoline: 0.5% or 0.5 g/100 g (or 3,695 mg/L) (Gustafson et al. 1997)

- Concentration of 1-methyl naphthalene in gasoline: 0.78% or 0.78 g/100 g (or approx. 5,760 mg/L) (estimated from Gustafson et al. 1997)

- Concentration of benzene in gasoline: 2.5% or 2.5 g/100 g (or 1.85×10^4 mg/L) (Hamilton 1996)

- Concentration of MTBE in gasoline: up to 15% or 15 g/100 g (or approx. 1.10×10^5 mg/L) (Hamilton 1996). (Note: MTBE concentrations in gasoline vary from state to state. Many states do not add MTBE.)

- Estimated emission of B(a)P in exhaust: 1080 µg/hr (from White and Carroll, 1998, using weighted average B(a)P emissions from two-cylinder, carbureted two-stroke liquid cooled snow mobile engine using gasoline and oil injected Arctic Extreme injection oil, 24-38:1 fuel:oil ratio. Weighted average based on percentage of time engine was in five modes of operation, from full throttle to idle).

- Estimated amount of B(a)P exhaust emissions retained in water phase = approximately 40% (based on value for B(a)P from Hare and Springier, quoted in North American Lake Management Society 2001).

Toxicity Benchmarks

A key part of the estimations is the water quality criterion, standard, or toxicological benchmark for each contaminant evaluated. There are no EPA water quality criteria for the protection of aquatic life for the PWC-related contaminants (EPA 1999a). There are, however, a limited number of EPA criteria for the protection of human health (via ingestion of water and aquatic organisms or ingestion of aquatic organisms only). Chronic ecotoxicological and human health benchmarks for contaminants were acquired from various sources.

Ecotoxicological benchmarks for benzo(a)pyrene, naphthalene, and benzene are from *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision* (Suter and Tsao 1996). The ecotoxicological benchmarks for benzo(a)pyrene (0.014 µg/L) and benzene (130 µg/L) are Tier II Secondary Chronic Values in table 1 of Suter and Tsao (1996), which were calculated using methods in the Great Lakes Water Quality Initiative (EPA 1993). The ecotoxicological benchmark for naphthalene (62 µg/L) is the EPA Region 4 chronic screening value (table 3 of Suter and Tsao 1996). This screening value was chosen for use as a conservative mid-range value considering the wide range of chronic values for naphthalene (12–620 µg/L) shown in Suter and Tsao (1996). The ecotoxicological benchmarks for 1-methyl naphthalene (19 and 34 µg/L) are based on LC_{50} values of 1900 and 3,400 µg/L for the marine invertebrate, Dungeness crab (*Cancer magister*), and the fresh water/estuarine fish, sheepshead minnow (*Cyprinodon variegatus*), respectively (USFWS 1987). The MTBE benchmarks of 18,000 and 51,000 µg/L are for marine and fresh water, respectively, and are based on the preliminary chronic water quality criteria presented in Mancini et al. (2002).

State water quality standards (including the numeric standards and descriptive text) must be reviewed and applied, as appropriate for each park being evaluated. The standards or criteria that fit the designated uses for the waters in the park must be used (for example, is it designated as a drinking water source or used only for support of aquatic life [fishing]?) This will determine which benchmarks are used: the "water

plus organism" benchmarks or the "aquatic organisms only" benchmarks. The correct benchmark must be used for either freshwater or marine/estuarine locations if there are different numbers provided for these two environments.

Following are the default toxicity benchmarks for the PAH, benzene, and MTBE having gasoline concentration information:

Chemical	Ecotoxicological Benchmark (µg/L)	Source	Human Health Benchmark[b] (µg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0044[b] 0.049[c]	EPA 1999a
Naphthalene	62	Suter and Tsao 1996	—	—
1-methyl naphthalene	19[a] 34[a]	USFWS 1987	—	—
Benzene	130	Suter and Tsao 1996	1.2[b] 71[c]	EPA 1999a
MTBE[d]	18,000 51,000	Mancini et al. 2002	13	CA DHS 2002

a. Based on LC_{50}s of 1,900 and 3,400 µg /L for Dungeness crab and sheepshead minnow, respectively (19 ug/L used for marine/estuarine calculations; 34 µg/L used for freshwater calculations).

b. Based on the consumption of water and aquatic organisms.

c. Based on the consumption of aquatic organisms only.

d. Ecotoxicological benchmarks, which are considered preliminary chronic water quality criteria, are 18,000 µg/L for marine and 51,000 µg/L for freshwater. There is no EPA human health benchmark, but the California Department of Health Services (2002) has established a primary maximum contaminant level (MCL) of 13 µg/L.

Example Calculations

Calculations of an example set of waterbody volume thresholds are provided below for the chemicals listed above together with their concentrations in gasoline and available toxicity benchmarks.

Loading to Water

Loadings of the five contaminants listed above are calculated for one day assuming 10 personal watercraft operate for four hours (40 PWC-hours), each discharging 11.34 L gasoline per hour and having concentrations in fuel or exhaust as listed.

Benzo(a)pyrene (from the fuel): 40 PWC-hrs × 11.34 L gas/hr × 2.07 mg/L = 939 mg

Benzo(a)pyrene (from the gas exhaust): 40 PWC-hrs × 1080 µg/hr × 1/1000 mg/µg × 0.40 = 17 mg

Total B(a)P = 956 mg

Naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 3695 mg/L = 1.68×10^6 mg

1-methyl naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 5764 mg/L = 2.62×10^6 mg

Benzene: 40 PWC-hrs × 11.34 L gas/hr × 1.85×10^4 mg/L = 8.39×10^6 mg

MTBE: 40 PWC-hrs × 11.34 L gas/hr × 1.10×10^5 mg/L = 4.99×10^7 mg

Loadings of contaminants from two-stroke outboards should be estimated based on the estimated loading based on the horsepower of the outboards involved (see "Assumptions and Constants" above) and the estimated hours of use, based on the types of boats and the pattern of use observed.

Threshold Volumes

Threshold volumes of water (volume at which a PWC- or outboard-related contaminant would equal the benchmarks listed above) are calculated by dividing the estimated daily loadings (mg of contaminant) for the number of operational hours (e.g., 40 PWC-hours) by the listed toxicity benchmark concentrations (µg/L), correcting for units (1 mg = 10^3 µg), and converting from liters to acre-feet (1 ac-ft = 1.234×10^6 L):

Protection of Freshwater Aquatic Organisms

Benzo(a)pyrene: 956 mg B(a)P × 10^3 µg/mg / 0.014 µg/L = 6.8×10^7 L or 55 ac-ft

Naphthalene: 1.68×10^6 mg naphthalene × 10^3 µg/mg / 62 µg/L = 2.71×10^7 L or 22 ac-ft

1-methyl naphthalene: 2.62×10^6 mg 1-methyl naphthalene × 10^3 µg/mg / 34 µg/L = 7.69×10^7 L or 62 ac-ft

Benzene: 8.39×10^6 mg benzene × 10^3 µg/mg / 130 µg/L = 6.45×10^7 L or 52 ac-ft

MTBE: 4.99×10^7 mg MTBE × 10^3 µg/mg / 51,000 µg/L = 9.78×10^5 L or 0.79 ac-ft

Based on these estimates and assumptions, 1-methyl naphthalene appears to be the contaminant (of those analyzed) that would be the first to accumulate to concentrations potentially toxic to freshwater aquatic organisms (i.e., it requires more water [62 ac-ft] to dilute the contaminant loading to a concentration below the toxicity benchmark). However, the threshold volumes are very similar for 1-methyl naphthalene, benzo(a)pyrene, and benzene.

Protection of Human Health

Benzo(a)pyrene: 956 mg B(a)P × 10^3 µg/mg / 0.0044 µg/L = 2.17×10^8 L or 176 ac-ft

Benzene: 8.39×10^6 mg benzene × 10^3 µg/mg / 1.2 µg/L = 6.99×10^9 L or 5,670 ac-ft

MTBE: 4.99×10^7 mg MTBE × 10^3 µg/mg / 13 µg/L = 3.83×10^9 L or 3,110 ac-ft (If the CA MCL of 13 µg/L for fresh water is used)

The California public health goal for MTBE is a drinking water–based MCL and is not as broadly applicable as the other criteria used in this analysis. However, it may be of interest, since MTBE is very soluble, and MTBE concentration could be an issue if the receiving body of water is used for drinking water purposes and MTBE is not treated. Using the numbers provided above, benzene would be the first PWC-related contaminant in these example calculations that would reach unacceptable levels in surface water; however, volatilization of benzene from water to air was not included in the calculation. MTBE would be the next contaminant to reach unacceptable concentrations. If human health water quality criteria for ingestion of aquatic organisms only were used for benzo(a)pyrene and benzene (0.049 µg/L and 71 µg/L, respectively), the corresponding threshold volumes would be 15.8 acre-feet and 95.8 acre-feet.

As a result of the estimated reductions in HC emissions (from the unburned fuel) in response to EPA regulations (listed above), additional personal watercraft and/or outboards may be used in the parks without additional impacts to water quality. For example, based on the expected overall reductions from EPA (1996a, 1997), up to twice the current number of personal watercraft/outboards may be used in a given area in 2012 without additional impacts to water quality over current levels. Effects on noise levels, physical disturbance, or hydrocarbon emissions that are products of combustion (e.g., B[a]P) may not be similarly ameliorated by the reduced emission regulations.

Application of Approach

Use of the approach described above for evaluating possible exceedance of standards or other benchmarks must be adapted to the unique scenarios presented by each park, PWC use, and waterbody being evaluated.

Factors that would affect the concentration of the contaminants in water must be discussed in light of the park-specific conditions. These factors include varying formulations of gasoline (especially for MTBE); dilution due to mixing (e.g., influence of the thermocline), wind, currents, and flushing; plus loss of the chemical due to volatilization to the atmosphere (Henry's Law constants can help to predict volatilization to air; see Yaws et al. 1993); adsorption to sediments and organic particles in the water column (e.g., PAH), oxidation, and biodegradation (breakdown by bacteria). Toxicity of phototoxic PAH may be of concern in more clear waters, but not in very turbid waters.

The chemical composition of gasoline will vary by source of crude oil, refinery, and distillation batch. No two gasolines will have the exact same chemical composition. For example, B(a)P concentrations may range from 0.19 to 2.8 mg/kg, and benzene concentrations may range from 0% to 7% (2% to 3% is typical). MTBE concentrations will vary from state to state and season to season, with concentrations ranging from 0% to 15%. The composition of gasoline exhaust is dependent on the chemical composition of the gasoline and engine operating conditions (i.e., temperature, rpm, and oxygen intake). If site-specific information is available on gasoline and exhaust constituents, they should be considered in the site-specific evaluation. If additional information on the toxicity of gasoline constituents (e.g., MTBE) become available, it should be considered in the site-specific evaluation.

Lastly, results of the studies included in the collection of papers entitled "Personal Watercraft Research Notebook" provided by the NPS staff, can be used to provide some framework for your analysis. The following table summarizes some of the results presented in various documents on the concentrations of benzene, PAH, and MTBE.

POLLUTANT CONCENTRATIONS REPORTED IN WATER

Pollutant	Source(s)	Levels Found	
		"Lower Use" (e.g. open water, offshore locations; reduced motorized watercraft use)	**"Higher Use" (e.g., nearshore, motorized watercraft activity high)**
Benzene	*Lake Tahoe Motorized Watercraft Report;* several studies reported		
	1. U.S. Geological Survey	1. <0.032 µg/l	1. 0.13 – 0.33 µg/l
	2. Miller and Fiore	2. ≤0.3 µg/l	2. just over 1 µg/l
	3. University of California	3. <0.1 µg/l	3. 0.1 – 0.9 µg/l
PAH	A. Mastran et al.	A. All below detection limits (<0.1 µg/l for pyrene and naphthalene; <2.5 µg/l for B(a)P, B(a)A, chrysene)	A. Total PAH – up to 4.12 µg/l in water column; total PAH – up to 18.86 µg/l in surface sample at marina, with naphthalene at 1 µg/l; B(a)P – ≥2.3 µg/l
	B. Ortis et al.	B. Experiment #1 – 2.8 ng/l phototoxic PAH	B. Experiment #1 – ± 45 ng/l phototoxic PAH; 5–70 ng/L total PAH
MTBE	A. *Lake Tahoe Motorized Watercraft Report;* several studies reported		
	1. U.S. Geological Survey	1. 0.11–0.51 µg/l	1. 0.3–4.2 µg/l
	2. Miller and Fiore	2. ≤3 µg/l	2. 20 µg/l (up to approx. 31 µg/l)
	3. University of California	3. less than nearshore area	3. up to 3.77 µg/l
	4. University of Nevada – Fallen Leaf Lake	4. —	4. 0.7–1.5 µg/l
	5. Donner Lake (Reuter et al. 1998)	5. <0.1 µg/l	5. up to 12 µg/l (Dramatic increase from 2 to 12 µg/l from July 4 to 7)
	B. NPS, VanMouwerik and Hagemann 1999		
	6. Lake Perris	6. 8 µg/l (winter)	6. up to 25 µg/l
	7. Shasta Lake		7. 9–88 µg/l over Labor Day weekend
	8. Three-day Jet Ski event		8. 50–60 µg/l
	9. Lake Tahoe		9. often within range of 20–25 µg/l, with max of 47 µg/l

APPENDIX B: LETTER OF CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/CO:NPS
MS 65412 GJ

October 16, 2002

Memorandum

To: Chief of Resource Stewardship and Science, National Park Service, Black Canyon of the Gunnison National Park, Gunnison, Colorado

From: Western Colorado Field Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado Allan R. Pfister

Subject: Request for Species List for Curecanti National Recreation Area, Gunnison, Colorado

We have received your September 12, 2002, correspondence requesting a list of federally threatened (FT) and endangered (FE) species that potentially could be affected from the proposed special regulation providing for continued use of personal watercraft on the flat-water portions of Blue Mesa Reservoir. You will also find that we have included federal candidate (FC) species. While candidate species have no protection under the Endangered Species Act, it is within the spirit of the Act to concern project impacts to potentially sensitive species. Additionally, we wish to make you aware of the presence of Federal candidates should any be proposed or listed prior to the time that all Federal actions related to the project are completed. Please be aware that endangered and threatened species lists should be updated every 90 days by telephone or in writing. If water depletions are or become part of the proposed project, you will need to formally consult for listed fish. To assist you in streamlining your project, the following list is disseminated from a county wide list of federally threatened and endangered species. If the scope of your project changes, you should reinitiate consultation with the Service for potential impacts to other listed species.

Federally Listed Species for the Curecanti National Recreation Area

Bald eagle (FT)	*Haliaeetus leucocephalus*
Southwestern willow flycatcher (FE)	*Empidonax traillii extimus*
Yellow-billed cuckoo (FC)	*Coccyzus americanus*
Canada lynx (FT)	*Lynx canadensis*
Boreal toad (FC)	*Bufo boreas boreas*

If the Service can be of further assistance, please contact John Kleopfer at the letterhead address or (970) 245-3920, extension. 39.

FWS/ES, Lakewood
JKleopfer:CurecantiSpLstMem.wpd:101602

GLOSSARY

BTEX — benzene, toluene, ethylbenzene, and xylene

National Ambient Air Quality Standards (NAAQS) — Concentrations of criteria pollutants in ambient air (outdoor air to which the public may be exposed) below which it is safe for humans or other receptors to be permanently exposed. The *Clean Air Act* establishes two types of national air quality standards. **Primary standards** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards has set national ambient air quality standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$).

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Standard Value[a]		Standard Type
Carbon Monoxide (CO)			
8-hour Average	9 ppm	(10 mg/m^3)	Primary
1-hour Average	35 ppm	(40 mg/m^3)	Primary
Nitrogen Dioxide (NO_2)			
Annual Arithmetic Mean	0.053 ppm	(100 $\mu g/m^3$)	Primary and Secondary
Ozone (O_3)			
1-hour Average	0.12 ppm	(235 $\mu g/m^3$)	Primary and Secondary
8-hour Average[b]	0.08 ppm	(157 $\mu g/m^3$)	Primary and Secondary
Lead (Pb)			
Quarterly Average	1.5 $\mu g/m^3$		Primary and Secondary
Particulate (PM_{10}) *Particles with diameters of 10 micrometers or less*			
Annual Arithmetic Mean	50 $\mu g/m^3$		Primary and Secondary
24-hour Average	150 $\mu g/m^3$		Primary and Secondary
Particulate ($PM_{2.5}$) *Particles with diameters of 2.5 micrometers or less*			
Annual Arithmetic Mean[b]	15 $\mu g/m^3$		Primary and Secondary
24-hour Average[b]	65 $\mu g/m^3$		Primary and Secondary
Sulfur Dioxide (SO_2)			
Annual Arithmetic Mean	0.03 ppm	(80 $\mu g/m^3$)	Primary
24-hour Average	0.14 ppm	(365 $\mu g/m^3$)	Primary
3-hour Average	0.50 ppm	(1300 $\mu g/m^3$)	Secondary

a. Parenthetical value is an approximately equivalent concentration.

b. The ozone 8-hour standard and the $PM_{2.5}$ standards are included for information only. A 1999 federal court ruling blocked implementation of these standards, which EPA proposed in 1997. EPA has asked the U.S. Supreme Court to reconsider that decision.

Nonroad Model — An air quality emissions estimation model developed by the U.S. Environmental Protection Agency to estimate emissions from various spark-ignition type "nonroad" engines. The June 2000 draft of the nonroad model was used to estimate air pollutant emissions from personal watercraft. It is available at <http://www.epa.gov/otaq/nonrdmdl.htm>.

Personal Watercraft (PWC) — As defined in 36 CFR 1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

SUM06 — The cumulation of instances when measured hourly average ozone concentrations equal or exceed 0.06 part per million (ppm) in a stated time period, expressed in ppm-hours.

Thermocline — The region in a thermally stratified body of water that separates warmer, oxygen-rich surface water from cold, oxygen-poor deep water. In a thermocline, temperature decreases rapidly with depth.

SELECTED BIBLIOGRAPHY

AWA	American Watercraft Association
CARB	California Air Resources Board
CDHS	California Department of Health Services
CPFPWS	Coalition of Parents and Families for Personal Watercraft Safety
FFWCC	Florida Fish and Wildlife Conservation Commission
IWL	Izaak Walton League of America
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NTSB	National Transportation Safety Board
ODEQ	Oregon Department of Environmental Quality
PWIA	Personal Watercraft Industry Association
USGS	U.S. Geological Survey

Albers, Peter H.
2000 "Sources, Fate, and Effects of PAHs in Shallow Water Environments." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Allen, B. C., J. E. Reuther, C. R. Goldman, M. F. Fiore, and G. C. Miller
1998 "Lake Tahoe Motorized Watercraft Report — An Integration of Water Quality, Watercraft Use and Ecotoxicology Issues." Preliminary draft report prepared for the Tahoe Regional Planning Agency.

American Academy of Pediatrics
2000 "Policy Watercraft Use by Children and Adolescents." Policy Statement. Pediatrics 105 (no. 2): 452–53.

American Canoe Association, David Jenkins
n.d. "Hostile Waters – The Impacts of Personal watercraft use on Waterway Recreation." Available on the Internet at <www.acanet.org>.

American Watercraft Association (AWA)
2001 "The Advocate Action Kit: Personal Watercraft and the Environment." Burbank, CA.

Anderson, Franz E.
2000 "Effect of Wave-wash from Personal Watercraft on Salt Marshes." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Andrews and Righter
1992 Colorado Birds: A Reference to Their Distribution and Habitat. Denver Museum of Natural History.

Arfsten, D.P., D.J. Schaeffer, and D.C. Mulveny
1996 "The Effects of Near Ultraviolet Radiation on the Toxic Effects of Polycyclic Aromatic Hydrocarbons in Animals and Plants: A Review." *Ecotoxicology and Environmental Safety* 33:1–24.

Asplund, Tim
2001 "The Effects of Motorized Watercraft on Aquatic Ecosystems." Draft paper. Wisconsin Department of Natural Resources and University of Wisconsin, Madison.

Bauch, Nancy J and Matt Malick
2003 Limnology of Blue Mesa, Morrow Point, and Crystal Reservoirs, Curecanti National Recreation Area, during 1999, and a 25 Year Retrospective of Nutrient Conditions in Blue Mesa Reservoir. USGS Water Resources Investigations Report 02-4199.

Bio Environs
2001 Protection for the Gunnison River Great Blue Heron Colony, Curecanti National Recreation Area, Gunnison, Colorado. Internal Report.

Bluewater Network
2001 "Jet Skis Position Paper." Available at <www.earthisland.org/bw/jetskipos.htm>.

Branche, C. M., J. M. Conn, J. L. Annest
1997 "Personal Watercraft-Related Injuries: A Growing Public Health Concern." *Journal of the American Medical Association* 278(8): 663–65.

Bureau of Land Management, U.S. Department of the Interior
2001 Gunnison Sage Grouse Conservation Plan. Available on the Internet at <http://www.co.blm.gov/gra/sagegrouse.htm>.

Burger, J.
1998 "Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns." *The Condor* 100: 528–34.

2000 "Managing Personal Watercraft around Tern Colonies." In *Impacts of Motorized Boats on Shallow Water Systems*. Science Workshop Abstracts, November 7 – 8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Burger, J., and J. Leonard
1999 "Conflict Resolution in Coastal Waters: the Case of Personal Watercraft." *Marine Policy* 24: 61–67.

California Air Resources Board
1998 "Proposed Regulations for Gasoline Spark-Ignition Marine Engines, Draft Proposal Summary." Mobile Resources Control Division.

1999 "Fact Sheet – New Regulations for Gasoline Engines." Available on the Internet at <www.arb.ca.gov/msprog/marine/marine.htm>.

2001 "Outboard Engine and Personal Watercraft Emissions to Air and Water: A Laboratory Study." Prepared by Mobile Source Control Division and Monitoring and Laboratory Division.

2002 National Ambient Air Quality Standards. Available on the Internet at <www.arb.ca.gov>.

California Department of Health Services
2002 "MTBE in California Drinking Water." Prevention Services, Division of Drinking Water and Environmental Management. Available on the Internet at <www.dhs.ca.gov/ps/ddwem/chemicals/MTBE/mtbeindex.htm> (latest update: August 7, 2002).

Coalition of Parents and Families for Personal Watercraft Safety
n.d. "Statistics." Available on the Internet at <http://www.pwcwatch.org/statistics.htm>.

Colorado Department of Public Health and Environment
2001a Antidegradation Significance Determination for New or Increased Water Quality Impacts, Procedural Guidance, Version 1.0. December 2001. Available on the Internet at <http://www.cdphe.state.co.us/wq/Assessment/Assess_pdf/ADGuidance.pdf>.

2001b Regulation No. 31, The Basic Standards and Methodologies for Surface Water (5CCR 1002-31). October 30, 2001. Available on the Internet at <http://www.cdphe.state.co.us/op/regs/waterregs/100231.pdf>.

2002a Colorado Air Quality Control Commission, Ambient Air Quality Standards. September 30 (most recent effective date).

2002b Colorado Air Quality Control Commission Report to the Public 2001-2002, October.

2002c Regulation No. 35, Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins. Available on the Internet at <http://www.cdphe.state.co.us/op/regs/waterregs/100235.pdf> (text) and <http://www.cdphe.state.co.us/op/regs/waterregs/100235tables.pdf> (tables). Accessed September 19, 2002.

Colorado Division of Labor and Employment, Division of Oil and Public Safety
2003 Personal communication with Dick Lockman (Inspector) by Janet Shangraw (JNS, Inc.), January 21. On file at JNS, Inc., Littleton, CO.

Colorado Division of Wildlife
2002a The Boreal Toad. Available on the Internet at <http://wildlife.state.co.us/aquatic/boreal/index.asp>.

2002b Coldwater Reservoir Ecology. Available on the Internet at <http://wildlife.state.co.us/aquatic/cold/index.asp>.

2002c Gunnison sage grouse species link. Available on the Internet at <http://wildlife.state.co.us/species_profiles/gunnisonsagegrouse.asp>.

Colorado Natural Heritage Program (CNHP)
2002 Colorado Rare Plant Guide. Available on the Internet at <www.ndis.nrel.colostate.edu/ndis/rareplants/>.

Colorado Plateau Cooperative Ecosystems Studies Unit (CPCESU)
2002 Available on the Internet at <http://cpcesu.nau.edu/pmis/index.htm>.

Colorado State Parks
2001 Colorado Boating Statutes and Regulations: Available on the Internet at <http://www.coloradoparks.org>. Accessed January 2003. <http://cpcesu.nau.edu/pmis/index.htm>.

Continental Shelf Associates for Personal Watercraft Industry Association
1997 "Effects of Personal Watercraft Operation on Shallow-water Seagrass Communities in the Florida Keys." Jupiter, FL. Dun & Bradstreet.

2001 *Industry Norms & Key Business Ratios.* Murray Hill, NJ: Dun & Bradstreet.

Earth Share of California
n.d. "The Hazards of Personal Watercraft." *Making Waves* 15, no. 3. Available on the Internet at <http://www.earthshareca.org/about/features/skidoos.htm>.

Federal Register
1998 "National Recommended Water Quality Criteria." *Federal Register* 63 (237):68354–681.

Florida Fish and Wildlife Conservation Commission
2000 "Buffer Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft in Florida (Study 7520)." Prepared by J. Rodgers Jr. Bureau of Wildlife Diversity Conservation. Gainesville, FL.

Gustafson, J. B., J. G. Tell, and D. Orem
1997 "Selection of Representative TPH Fractions Based on Fate and Transport Considerations." Final draft. Vol. 3. TPH Criteria Working Group, Fate and Transport Technical Action Group. Amherst Scientific Publishing.

Hamilton, Bruce
1996 "FAQ: Automotive Gasoline." 4 parts. Available on the Internet at <www.faqs.org/faqs/autos/gasoline-faq>.

Hare, C. T., and K. J. Springier
1973 "Exhaust Emissions from Uncontrolled Vehicles and Related Equipment Using Internal Combustion Engines." Final Report. Part Two: "Outboard Motors." Prepared for the U.S. Environmental Protection Agency by Southwest Research Institute, San Antonio, TX. Available on the Internet at <http://www.nalms.org/bclss/impactsoutboard.htm>.

Harris, Miller, Miller, Hanson, Inc.
2002 "Draft Environmental Impact Statement, Personal Watercraft Rule-Making." Glen Canyon National Recreation Area, Arizona and Utah. NPS 608 D-228, August.

Hayes, Reagan
2002 "Can A New Breed of PWC Stem Sales Decline?" *Soundings Trade Only,* February. Soundings Publication LLC. Available on the Internet at <http://www.pwia.org/articles01.htm>. Accessed June 24, 2002.

Hyde, Dr. A. S., and Kevin J. Cook.
1980 A Checklist to the Birds of Curecanti National Recreation Area. Southwest parks and Monuments Assoc. Unpaginated. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. Available on the Internet at <http://www.npwrc.usgs.gov/resource/othrdata/chekbird/r6/curecan.htm>. (Version 18JUL00).

Izaak Walton League of America
1999 *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin. Available on the Internet at <http://www.iwla.org>.

Jacques Cousteau National Estuarine Research Reserve and New Jersey Department of Environmental Protection, Coastal Management Program
2000 "Impacts of Motorized Boats on Shallow Water Systems." Science Workshop Abstracts, Nov. 7–8, 2000. Douglass College Center, Rutgers, the State University of New Jersey.

Kado, Norman Y., Paul A. Kuzmicky, and Robert A. Okamoto
2001 *Environmental and Occupational Exposure to Toxic Air Pollutants from Winter Snowmobile Use in Yellowstone National Park.* University of California Davis, California Air Resources Board.

Kado, Norman Y., Robert F. Okamoto, John Karim, and Paul A. Kuzmicky
2000 "Airborne Particle Emissions from two-stroke and four-stroke Outboard Marine Engines: Polycyclic Aromatic Hydrocarbon and Bioassay Analyses." *Environmental Science & Technology* 34(13): 2714–20.

Kawasaki Country
2001 Personal communication with Rodney Moore (Manager) by Erica Koch (URS Corp.), September 5. On file at URS Corporation, Denver, CO.

Kingery, Hugh E.
1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership with Colorado Division of Wildlife.

Komanoff, Charles, and Howard Shaw
2000 *Drowning in Noise: Noise Costs of Jet Skis in America.* A Report for the Noise Pollution Clearinghouse. Available on the Internet at <http://www.noise.org/library/drowing>.

Landrum, P.F., J.P. Geisy, J.T. Oris, and P.M. Allred
1987 "Photoinduced Toxicity of Polycyclic Aromatic Hydrocarbons to Aquatic Organisms." In *Oil in Freshwater: Chemistry, Biology, Countermeasure Technology,* edited by J.H. Vandermeulen and S.E. Hrudey, 304–18, Ontario, Canada: Pergamon Press.

LAW Engineering and Environmental Sciences, Inc., BBL Sciences, and RTI
2002 "Economic Analysis of Personal Watercraft Regulations in Curecanti National Recreation Area." Prepared for the National Park Service. Kennesaw, GA.

Mace, B. E., R. D. Nine, N. N. Clark, T. J. Vanyo, V. T. Remcho, and R. W. Morrison
1998 "Emissions from Marine Engines with Water Contact in the Exhaust Stream." SAE Technical Paper Series. Warrendale, PA.

Mancini, E. R., A. Steen, G. A. Rausina, D. C. L. Wong, W. R. Arnold, F. E. Gostomski, T. Davies, J. R. Hockett, W. A. Stubblefield, K. R. Drottar, T. A. Spring, and P. Errico
2002 "MTBE Ambient Water Quality Criteria Development: A Public/Private Partnership." *Environmental Science and Technology* 36: 125–29.

Mastran, Trina A., Andrea M. Dietrich, Daniel J. Gallagher, and Thomas J. Grizzard
1994 "Distribution of Polyaromatic Hydrocarbons in the Water Column and Sediments of a Drinking Water Reservoir with Respect to Boating Activity." *Water Resources* 28 (11): 2353–66.

McCall, Steve
2002 Personal communication from S. McCall, Environmental Specialist, Western Colorado Area Office, Bureau of Reclamation, October 29, 2002.

Mekenyan, O.G., G.T. Ankely, G.D. Veitt, and D.J. Call
1994 "QSARs for Photoinduced Toxicity: I. Acute Lethality of Polycyclic Aromatic Hydrocarbons into Daphnia Magna." *Chemosphere* 28:56782.

Mestre Greve Associates
1992 Noise Assessment for Beaver Basin Rim Road. Pictured Rocks National Lakeshore. Prepared for the National Park Service. Newport Beach, CA.

National Academy of Sciences
1972 *Particulate Polycyclic Organic Matter.* Washington, DC.

Natural Diversity Information System
2002 System for Conservation Planning (SCoP) website. Available on the Internet at <http://ndis.nrel.colostate.edu/escop/>.

National Marine Manufacturers Association (NMMA)
2000 *1999 U.S. Recreational Boat Registration Statistics.* Chicago, IL.

2002 "U.S. Recreational Boat Registration Statistics." Chicago, IL. Available on the Internet at <http://www.nmma.org/facts/boatingstats/2001/files/populationestimates.asp>.

National Park Service, U. S. Department of the Interior
n.d. *Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida.* Washington, DC.

1994 "Curecanti National Recreation Area: Archeological Overview and Assessment (Revised)." Park files.

1995a *How to Apply the National Register Criteria for Evaluation.* Available on the Internet at <www.cr.nps.gov/nr/publications/bulletins/>.

1995b Secretary of the Interior's Standards for the Treatment of Historic Properties. Available on the Internet at <www2.cr.nps.gov/tps/secstan1.htm>.

1996 *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes.* Washington, DC.

1997 General Management Plan for Black Canyon of the Gunnison National Monument and Curecanti National Recreation Area. Available at the Technical Information Center, Denver Service Center, file number D-63B. Denver, CO.

1998 "Proposed Rule on Personal Watercraft Use within the NPS System." Available on the Internet at <http://www.nps.gov/refdesk/1pwcrule.html>.

1999 "Water Quality Concerns Related to Personal Watercraft Usage," by M. VanMouwerik and M. Hagemann. Technical paper. Water Resources Division, Fort Collins, CO.

2000a *Director's Order #9: Law Enforcement Program,* and *Reference Manual #9: Law Enforcement.* Washington, DC. Available on the Internet at <http://www.nps.gov/policy/DOrders/DOrder9.html>.

2000b *Director's Order #47: Sound Preservation and Noise Management.* Washington, DC. Available on the Internet at <http://www.nps.gov/policy/DOrders/DOrder47.html>.

2000c *Management Policies 2001.* Washington, DC. Available on the internet at <http://www.nps.gov>.

2000d Vessel registration survey results for Curecanti National Recreation Area.

2001a Director's Order #12: *Conservation Planning, Environmental Impact Analysis, and Decision-making,* and *Handbook.* Washington, DC. Available on the internet at <http://www.nps.gov/policy/DOrders/DOrder12.html> and <http://www.nps.gov/policy/DOrders/RM12.pdf>.

2001b Rosenlieb, NPS, WRD, personal communication. 2001.

2001c "Strategic Plan for Curecanti National Recreation Area, October 1, 2001 – September 30, 2005."

2002a "American Indian Affiliation: Curecanti National Recreation Area," by David Ruppert. Technical paper. Intermountain Support Office, Denver, CO.

2002b Curecanti National Recreation Area Website. Dams and Reservoirs. Available on the Internet at <http://www.nps.gov/cure/webvc/dams.htm>. Accessed September 17, 2002.

2002c Curecanti National Recreation Area. Personal communications with Park staff Linda Alick, Ken Stahlnecker, Matt Malick, Schelle Frye, Ryan Thrush, Forest Frost. September 11-13, 2002.

2002d L. Alick and M. Malick, NPS, personal communication, K. Lusby, EDAW, November 14, 2002.

2002e NPS Visitor Use Statistics website. Available on the Internet at <http://www2.nature.nps.gov/stats/>.

2002f Preliminary Study Summary, Water Quality Results, Curecanti National Recreation Area. Mark Van Mouwerik, Contaminants Specialist, National Park Service Water Resources Division. Obtained September 11, 2002.

2002g "Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority." Available at park headquarters, Gunnison, CO.

National Research Council, National Academies of Science
2002 *Oil in the Sea III: Inputs, Fates, and Effects.* Washington, DC: National Academy Press.

National Transportation Safety Board
1998 *Personal Watercraft Safety.* Safety Study NTSB/SS-98/01. Washington, D.C.

Noise Unlimited, Inc.
1995 "Boat Noise Tests Using Static and Full-Throttle Measurement Measures." Prepared for the State of New Jersey, Department of Law and Public Safety.

Norkus, George E.
1999 Available on the Internet at <http://detroit.freenet.org/sigs/boating/html/data_undr2.html>.

North American Lake Management Society
1999 "Impacts of Outboard Motors on the Aquatic Environment." Prepared by Patrick Warrington. Available on the Internet at <http://www.nalms.org/bclss/impactsoutboard.htm>.

O'Connor, Thomas P.
2000 "Small Boat-derived Chemical Contamination in a National Context." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Oregon Department of Environmental Quality
1999 "Carbureted Two-Stroke Marine Engines: Impacts on the Environment and Voluntary Policy Options to Encourage Their Replacement." Final report. Prepared by Mindy Correll, Pollution Prevention Team. Portland, OR. Available on the Internet at <http://www.deq.state.or.us/programs/P2/reports/marine_engines.html>.

Oris, J. T., A. C. Hatch, J. E. Weinstein, R. H. Findlay, P. J. McGinn, S. A. Diamond, R. Garrett, W. Jackson, G. A. Burton, B. Allen
1998 "Toxicity of Ambient Levels of Motorized Watercraft Emissions to Fish and Zooplankton in Lake Tahoe, California/Nevada, USA." Poster 3E-P005, presented at the 8th Annual Meeting of the European Society of Environmental Toxicology and Chemistry, April 14–18, 1998, University of Bordeaux, Bordeaux, France.

Pearce, D., and D. Moran
1994 *The Economic Value of Biodiversity.* London: Earthscan Publication.

Personal Watercraft Industry Association
2000 "Sound Level Comparisons." Available on the Internet at <http://www.pwia.org/snd_pwc.htm>.

2002a PWIA correspondence to NPS, May 28, 2002: comment on *Lake Mead National Recreation Area Lake Management Plan and Draft Environmental Impact Statement*.

2002b PWIA email to NPS dated September 23, 2002.

Rodgers, James A., Jr., and Stephen T. Schwikert
2002 "Buffer-Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft and Outboard-Powered Boats." *Conservation Biology* 16 (February): 216–24.

Rosenberger, Randall, and John Loomis
2000 "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4): 1097–1107.

Sea-Doo
2000 "Personal Watercraft FACTS." Available on the Internet at <http://www.ozpwc.com/thefacts.html>.

2001a "Bombardier Announces Revolutionary New O.P.A.S. System." Available on the Internet at <http://www.seadoo.com/usa/seadoo_today/news/010827.html>.

2001b "The New 155 hp, 1494 cc 4-TEC, Four-Stroke." Available on the Internet at <http://www.seadoo.com>.

Society of Automotive Engineers
2001 "Exterior Sound Level Measurement Procedure for Pleasure Motorboats." J34. Marine Sound Level Subcommittee. Available on the Internet at <www.sae.org>.

State of Colorado Department of Local Affairs
2001 Colorado Demography Section. Available on the Internet at <http://www.dola.state.co.us/demog/population/populationtotals/current estimates/01-table2.pdf>. Accessed January 2003.

Stevenson, J. C., and W. C. Dennison
2000 "The Potential Impacts of Recreational Boating on Submersed Aquatic Vegetation in Upper Chesapeake Bay." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Suter, G. W., and C. L. Tsao
1996 *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*. Rev. ES/ER/TM-96/R2. Oak Ridge National Laboratory, TN.

Tahoe Regional Planning Agency
1998 "Lake Tahoe Motorized Watercraft Report – An Integration of Water Quality, Watercraft Use and Ecotoxicology Issues." Preliminary draft report prepared for the Tahoe Regional; Planning Agency.

1999 *Environmental Assessment for the Prohibition of Certain Two-Stroke Powered Watercraft.*

Tjarnlund, U., G. Ericson, E. Lindersjoo, I. Petterson, and L. Balk
1995 "Investigation of the Biological Effects of 2-Cycle Outboard Engines' Exhaust on Fish." *Marine Environmental Research* 39: 313–16.

Tjarnlund, U., G. Ericson, E. Lindesjoo, I. Petterson, G. Akerman, and L. Balk
1996 "Further Studies of the Effects of Exhaust from Two-Stroke Outboard Motors on Fish." *Marine Environmental Research* 42: 267–71.

U.S. Coast Guard
2001 M. Schmidt, personal communication, September 4, 2001.

U.S. Department of Energy

2002 "Feature Article- Controversial Additive, MTBE, Gradually Phased out by States". National Biomass Coordination Office, U.S. Department of Energy, Efficiency and Renewable Energy (EERE). August, 2002. Accessed on Internet. No longer available on the internet. Available through the administrative record for the project on file with the National Park Service.

U.S. Department of the Interior, United States Fish and Wildlife Service
1987 "Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review," by R. Eisler. Biological Report 85; Contaminant Hazard Reviews Report 11. Laurel, MD.

2002 October 16, 2002 personal communication Kleopfer, J. (letter to Curecanti staff Regarding listed species potentially affected).

n.d. Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida. Washington, D.C.

U.S. Environmental Protection Agency
1974 "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an adequate Margin of Safety." EPA 550/9-74-004. Washington, DC. Cited in Izaak Walton League of America, 1999, *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin.

1994 "The Effects of Marine Engine Exhaust Emissions on Water Quality: Summary of Findings of Various Research Studies." Office of Air and Radiation.

1996a "Air Pollution Control; Gasoline Spark-Ignition Marine Engines; New Nonroad Compression-Ignition and Spark-Ignition Engines, Exemptions; Rule." *Federal Register* 61 (Oct. 4): 52087–106.

1996b "Emission Standards for New Gasoline Marine Engines." EPA 420-F-96-012. EPA Environmental Fact Sheet. Office of Mobile Sources, Ann Arbor, MI.

1996c *Regulatory Impact Analysis: Control of Air Pollution Emission Standards for New Nonroad Spark-Ignition Marine Engines.* ANR-443. Office of Air and Radiation, Office of Mobile Sources, Engine Programs and Compliance Division, Ann Arbor, MI.

1997 "Control of Air Pollution; Amendment to Emission Requirements Applicable to New Gasoline Spark-Ignition Engines." *Federal Register* 62 (April 2): 15805–08.

1998 "National Recommended Water Quality Criteria." *Federal Register* 63 (Dec. 10): 68353–64.

1999 "National Air Quality Trends Report." 1999. Available on the Internet at <http://www.epa.gov/oar/aqtrnd99/>. Accessed November 2002.

1999a "National Recommended Water Quality Criteria — Correction." EPA822-Z-99-001. Office of Water.

1999b "Power Boating and America's Waters." Available on the Internet at <http://www.epa.gov/CEIS/atlas/ohiowaters/uses/power_boating_and_america.htm>.

2000a Air Trends Report for Year 2000. Available on the Internet at <http://www.epa.gov/airtrends/vis2.html>.

2000b "Recreational Vehicles, Marine Engines." Region III, Air Protection Division. Available on the Internet at <http://www.epa.gov/reg3artd/vehicletran/vehicles/recreational_vehicles.htm>.

2001 "National Primary Drinking Water Regulations: Technical Fact Sheet on Benzene." Office of Water. Available on the Internet at <www.epa.gov/ogwdw000/dwh/t-voc/benzene.htm>.

2002a Action on Revisions to the Water Quality Standards for the Gunnison and Lower Dolores River Basin. Available on the Internet.

2002b "Air and Radiation, National Ambient Air Quality Standards (NAAQS)." Available on the Internet at <http://www.epa.gov/airs/criteria.html>. Accessed November 2002.

2002c "National Recommended Water Quality Criteria — Correction." EPA822-Z-99-001. Office of Water.

2002d National Recommended Water Quality Criteria :2002. http://www.epa.gov/waterscience/pc/revcom.pdf Office of Water; EPA-822-R-02-047; November 2002 <accessed 03/31/03>.

2002e Ozone data available on the Internet at <http://www.epa.gov/castnet/ozone.html>.

2003a EPA Air and Radiation website. Available on the Internet at <http://www.epa.gov/cgi-bin/epaprintonly.cgi>.

2003b "National Ambient Air Quality Standards." <http://www.epa.gov/airs/criteria.html>.

U.S. Fish and Wildlife Service

2000 Federal Register Notice of Designation of the Gunnison Sage Grouse as a Candidate Species. Volume 65, Number 250. December 28, 2000.

2002 John Kleopfer, personal communication, October 16, 2002.

U.S. Geological Survey, U.S. Department of the Interior

2001 "Occurrence and Potential Adverse Effects of Semivolatile Organic Compounds in Streambed Sediment, United States, 1992-1995," by T. J. Lopes and E. T. Furlong, USGS, Carson City, NY. Available from USGS Denver Federal Center, Denver, CO 80225-0046.

Verschuren, K.

1983 *Handbook of Environmental Data on Organic Chemicals.* 2nd ed. New York: Van Nostrand Reinhold Company.

Vlasich, Brian
1998 "Personal Watercraft: Environmental Effects of a 'Thrill-Craft.'" Claremont Environmental Policy Briefs, Student Edition. Roberts Environmental Center, Claremont McKenna College, Claremont, CA.

Wark, Kenneth, and Cecil F. Warner
1981 *Air Pollution: Its Origin and Control*. 2nd ed. New York: Harper and Row, Publishers.

Warrington, P.
1999 Information extracted from "Impacts of Recreational Boating on the Aquatic Environment," Available on the Internet @ http://www.nalms.org/bclss/impacts recreationboat.htm.

White, J. J., J. N. Carroll
1998 "Emissions from Snowmobile Engines Using Bio-Based Fuels and Lubricants." Final Report. Prepared for Montana Department of Environmental Quality, Helena, MT.

Winger, Parley V.
2000 "Toxicological Assessment of Aquatic Ecosystems." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Wong, D. C. L., W. R. Arnold, G. A. Rausina, E. R. Mancini, and A. E. Steen
2001 "Development of a Freshwater Aquatic Toxicity Database for Ambient Water Quality Criteria for Methyl Tertiary-Butyl Ether." *Environmental Toxicology and Chemistry* 20 (5): 1125–32.

Yamaha Motor
2001 "World's First four-stroke Personal Watercraft." Available on the Internet at <http://www.yamaha_motor.com/new/07_19_01_wc_press.html>.

Yaws, C. L., Pan Xiang, and Lin Xiaoyin
1993 "Water Solubility Data for 151 Hydrocarbons. *Chemical Engineering,* 100 (n.2): 108–11.

LIST OF PREPARERS

NATIONAL PARK SERVICE

AIR RESOURCES DIVISION, WASHINGTON OFFICE

Tamara Blett, Ecologist. M. S., Forest Ecology. Assisted in developing air quality methodology. Experience: 15 years air resource management experience with the National Park Service and USDA Forest Service.

John D. Ray, Program Manager for the Gaseous Pollutant Monitoring Program. Ph.D., Chemistry. Assisted in developing air quality methodology. Atmospheric chemist. Experience: 9 years with National Park Service.

Aaron Worstell, Environmental Engineer. B.S., Chemical Engineering. Assisted in developing air quality methodology. Experience: 9 years experience in air quality (5 federal, 4 state).

ENVIRONMENTAL QUALITY DIVISION, WASHINGTON OFFICE

Sarah Bransom, Compliance Program Coordinator. MRP (Master's Degree, Environmental Planning). Managed all PWC environmental assessments for the National Park Service. Experience: 24 years NEPA compliance (federal service).

INTERMOUNTAIN REGION SUPPORT OFFICE

Rick Ernenwein, Overflights and Noise Program Coordinator. B. S., Renewable Natural Resources. Assisted in developing soundscape methodology. Experience: 15 years with NPS noise and NEPA issues; 23 years federal service.

WATER RESOURCE DIVISION, WASHINGTON OFFICE

Gary Rosenlieb, Hydrologist, Water Quality Program Coordinator. M. S., Water Resources Management. Assisted in developing water quality methodology. Experience: 23 years federal service, with primary experience in water quality management and environmental impact analysis for water resources issues.

Mark VanMouwerik, Contaminants Specialist / CSU Research Associate. M. S., Environmental Health. Worked with fate and effects on contaminants in the environment. Experience: 5 years with National Park Service.

CONSULTANTS

EDAW, INC.

Joan DeGraff, Senior Environmental Planner. Certification in Historic Preservation; M.A., History and Political Science; B.S., History and Criminal Justice. Project lead; coordination with NPS representatives on project-related issues; Experience: 14 years federal experience in Section 106

compliance, NEPA environmental compliance, preparation of environmental assessment and environmental impact statements, and project management.

Debra J. Dickey, Environmental Planner and Technical Writer. M.S., Environmental Studies; B.S., Landscape Architecture. Responsible for visitor experience and safety analysis. Experience: 6 years in landscape architecture, environmental planning, technical writing, and document coordination.

Suzanne M. Fromson, Landscape Designer. BLA. Assisted in preparing site plans and illustrative graphics. Experience: 3 years of design and planning projects ranging from urban design to wetland restoration.

Kimberly Havens, Environmental Analyst. B.A., Environmental Studies. Responsible for research and report writing. Experience: More than 1 year in environmental analysis.

Nicole C. Korbe, Environmental Planner and Biologist. B.S., Biology with emphasis in Botany; Graduate studies in Plant Ecology and Hydrology. Responsible for wildlife and vegetation analysis. Experience: 5 years in habitat assessment and surveys for special status plant and wildlife species, wetland delineation and regulation, vegetation population studies, and report preparation.

James Kurtz, Senior Acoustics and Air Quality Engineer. B.S., Engineering. Responsible for air quality and soundscape analyses. Experience: More than 20 years in air quality; more than 13 years in environmental acoustics.

Karen Z. Lusby, Senior Associate/Environmental Planner. M.S., Forest Economics; B.S. Outdoor Recreation and Park Administration. Responsible for program management, PWC and boating estimates, and technical review of document. Experience: 19 years in NEPA environmental compliance and documentation, resource and park planning, NPS NEPA compliance, and project management.

Michael A. Morelli, Senior Associate/Landscape Architect/Environmental Planner. MLA, Landscape Architecture and Planning; B.A., Environmental Design. Responsible for coordination and quality assurance of alternative maps and graphics. Experience: 25 years in NEPA environmental compliance and documentation, recreational planning, landscape architecture, facilities planning, NPS NEPA compliance and project management.

JNS, INC.

Janet N. Shangraw, President / Water Hydrologist (AIH). B.S. Hydrology. Responsible for surface water quality analyses. Experience: Over 23 years of technical and management experience in surface water hydrology and NEPA analysis.

RED, INC. COMMUNICATIONS

Juanita Barboa, Technical Writer/Editor. B.S. Technical Communication. Responsible for editing. Experience: 14 years of experience writing, editing, and coordinating production of technical documents.

Cheryl Priest, Desktop Publisher/Text Processor. Responsible for formatting and layout. Experience: 13 years of experience in word processing, document preparation, and formatting of technical documents.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-89 (April 2003)